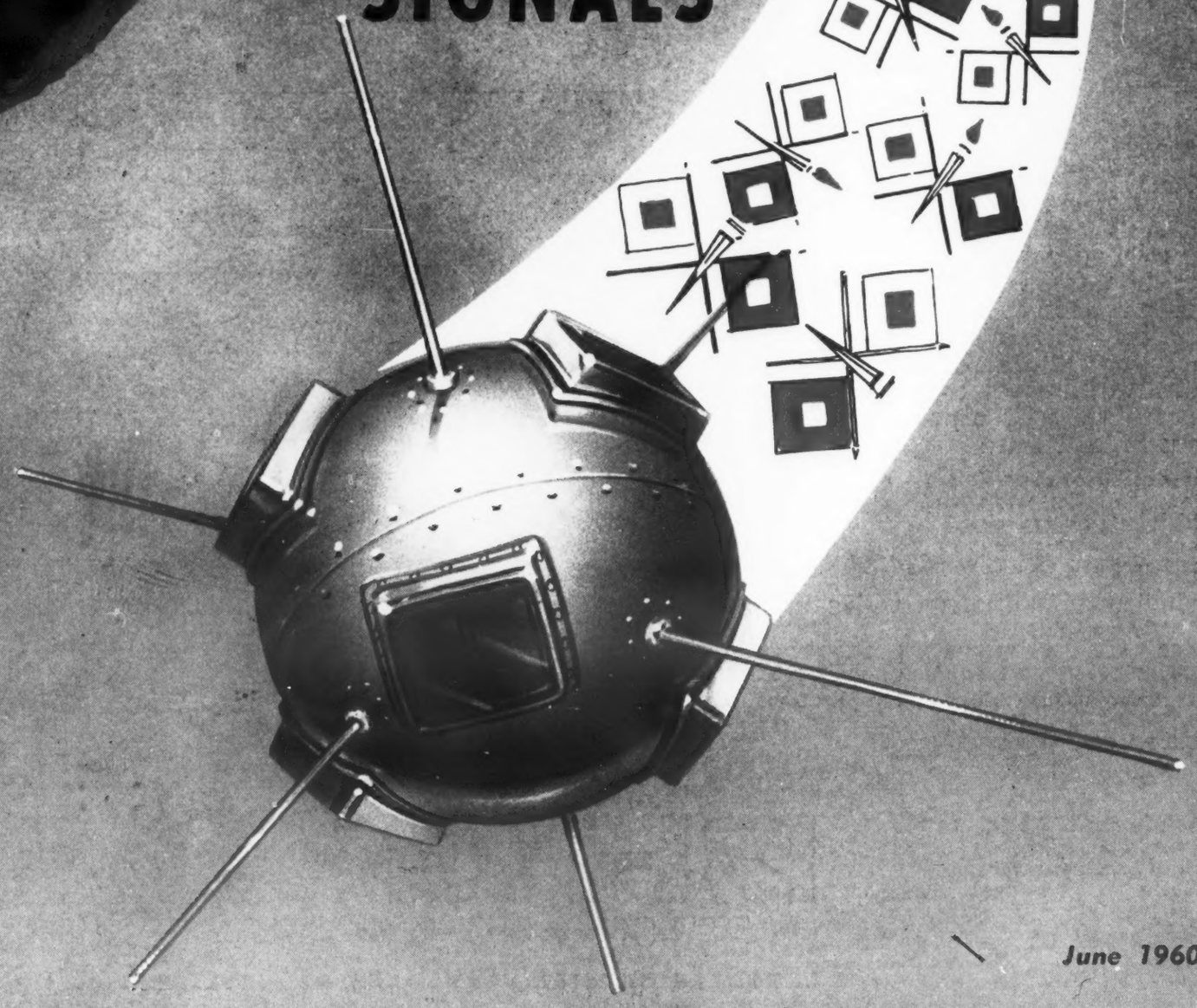
SIGNAL

A century

1860 - 1960

of

US ARMY SIGNALS



June 1960

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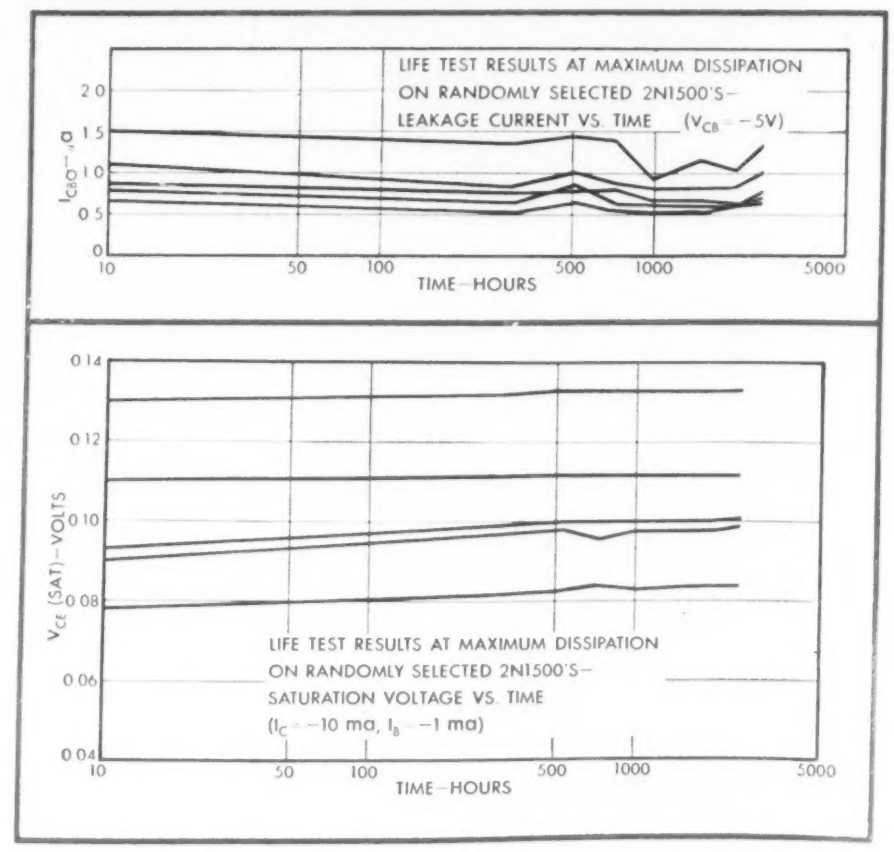
For complete specifications and applications data, write Dept. S660.



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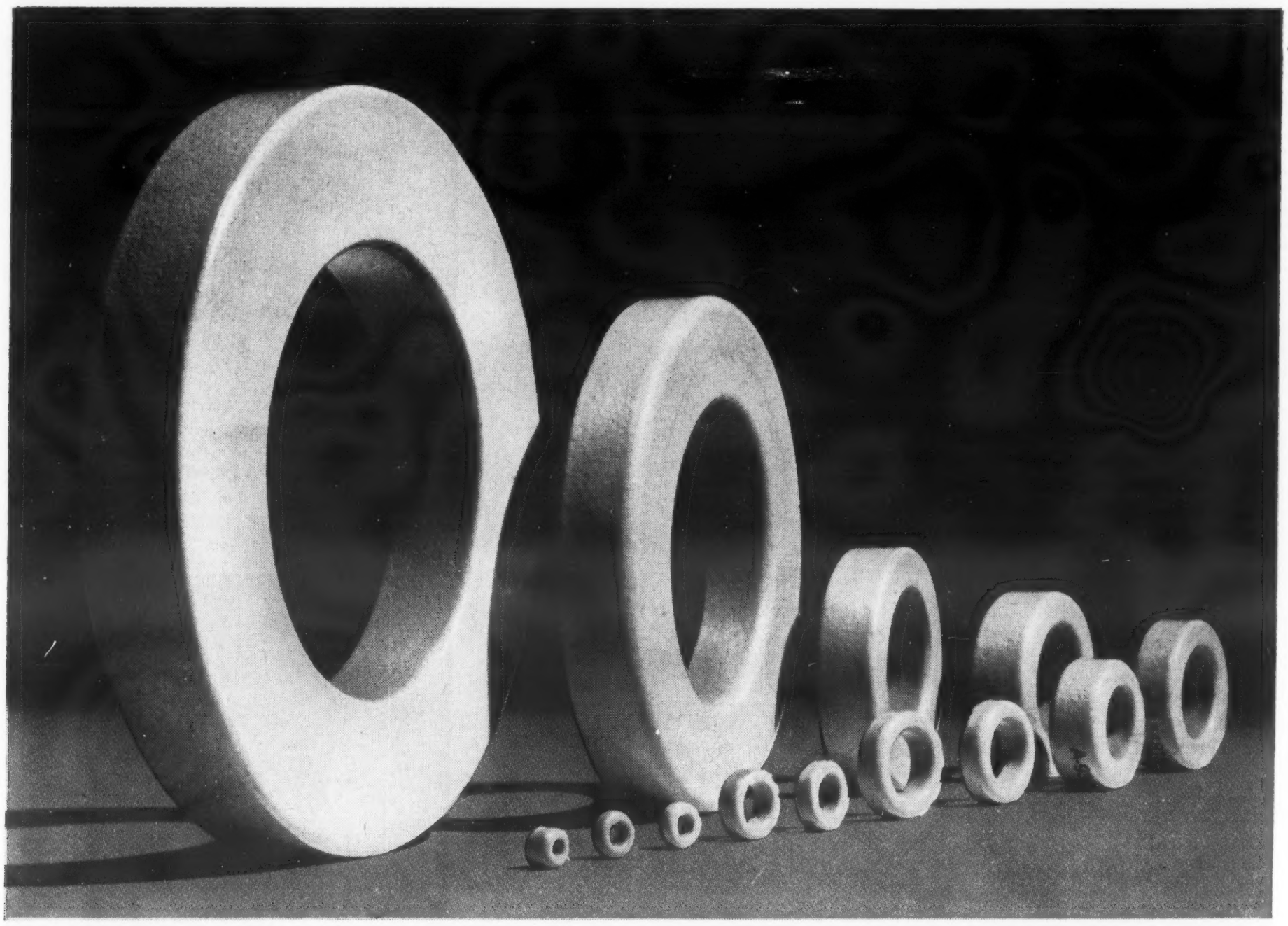
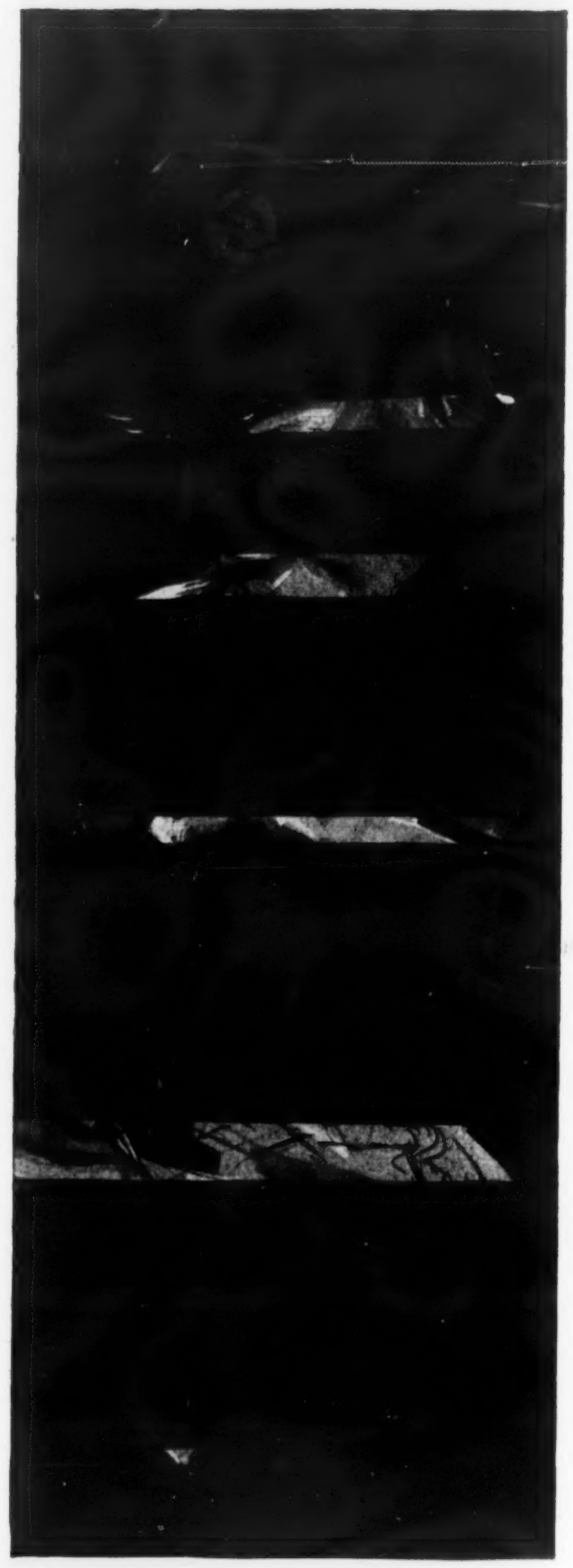


clear concise communications



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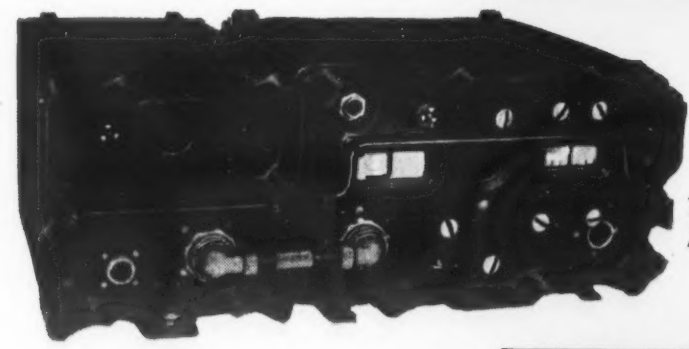

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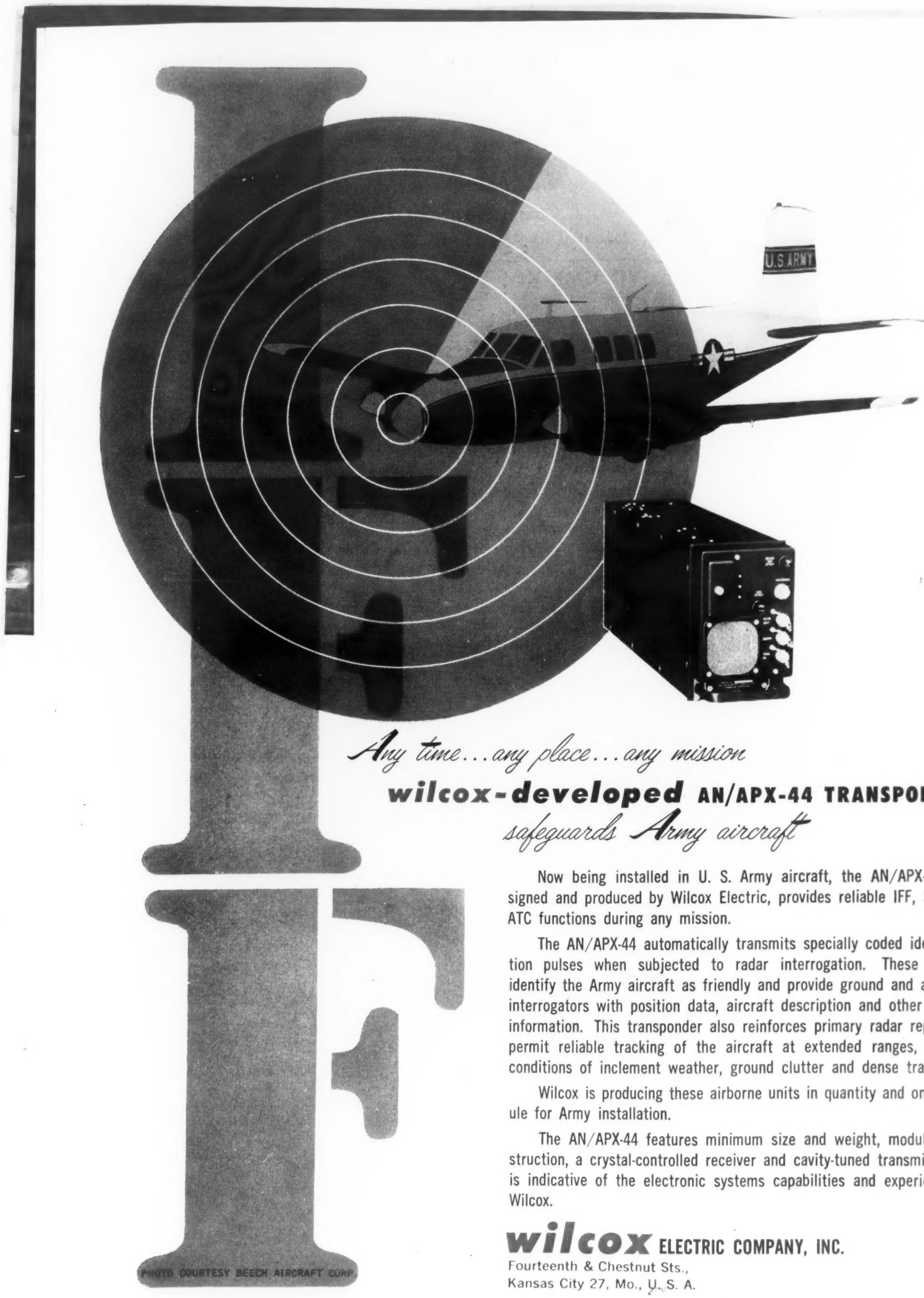

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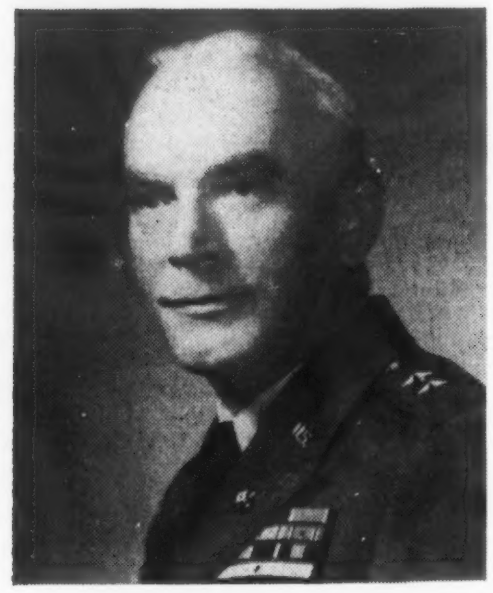
SIGNAL SALUTES US ARMY SIGNAL CORPS

The Officers, National Directors and membership of the Armed Forces Communications and Electronics Association salute the United States Army Signal Corps on the occasion of its Centennial.

We congratulate the Corps for one hundred years of progress in contributing to the military posture of an ever-modern Army. May your second century be as progressive as the first in your efforts to advance our increasing capabilities in communications.

THE EDITOR

Centennial Message of the Chief Signal Officer



Maj. Gen. R. T. Nelson
Chief Signal Officer, USA

THE UNITED STATES ARMY Signal Corps celebrates its 100th Anniversary this year. It has been a century of Army progress in the science of communication. We have advanced from signaling by flag, torch and telegraph along the Potomac and at Manila Bay to a communications satellite relaying messages from outer space.

Since our beginning under Brigadier General Albert J. Myer, the Signal Corps has provided military signaling systems to the Army and operated them in combat. Our achievements have supported not only American fighting men, but civilian endeavors at home and abroad.

We are proud of our age. We are prouder still to be the communications-electronics arm of a never-beaten Army whose victories have always advanced the cause of assuring men their natural, God-given rights.

All Signal Corps personnel — Active, Reserve, and National Guard — military and civilian — have unselfishly contributed to the military posture of an ever-modern Army and the Nation. They have given of their talents and their knowledge. They have given of their courage and their lives.

Signalmen were at Bull Run and Gettysburg — separated only by their uniforms and their convictions. One of our Medals of Honor was earned outside Manila, carrying communications forward under fire. Men with crossed flags on their collars fell in France, in North Africa, and the Philippines. And Signalmen were among the very first to give their lives in Korea.

We have a distinguished heritage in executing our dual mission as a combat arm and a technical service: The Myer flag and code system, his Flying Telegraph Train, the Beardsley magneto telegraph, the Nation's first weather service, Alaskan communications, the first military airplane, the first American radar, the first operational electronic air defense system for Army missile batteries, the first weather satellite, and the first communications satellite, are but some of the Army Signal Corps' contributions to our country.

The United States Army's superiority in battle is sustained by firepower, mobility and command control. While supporting all three, it is to the last that the Signal Corps is primarily dedicated — through strategic and tactical communications, combat surveillance and target acquisition, pictorial support, electronic warfare, avionics for Army aircraft, and in the broadening field of space and satellite electronics and communications.

Aware of the Nation's inherent need for the Army and the requirement that it be kept highly modern, we are—together with American Industry—engaged in research, training and development of equipment which we believe will add new dimensions to the nature of communications itself.

As we enter our second century, our energies will continue to be dedicated to increasing the Army's combat readiness. We firmly believe that improved communications among the people of the world proportionately advance the cause of peace. And in helping to bring about a greater exchange of ideas and understanding, we find our most enduring source of pride.

It is my privilege to be Chief Signal Officer of the Army in this hundredth year of our service. To the military and civilian members of the U. S. Army Signal Corps throughout the world, I offer my heartiest congratulations for the jobs you have done and my best wishes in your future undertakings. You and those before you have made our successes. You are the *people* who aggressively face a challenging future.

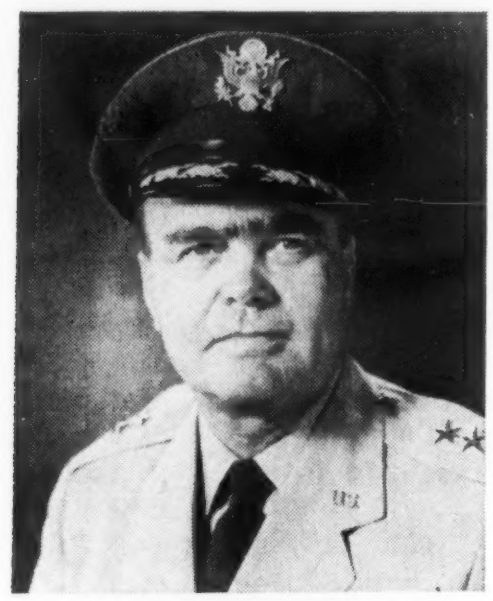
Good luck, happiness, and God bless each of you in this great Corps. I look to your individual skills and dedication to perpetuate the spirit of *Pro Patria Vigilans*—For our Country, Ever Vigilant.

★ ★ ★ ★

Maj. Gen. Earle F. Cook
Deputy Chief Signal Officer

Service Communicators Salute the United States Army Signal Corps

RAdm. Frank Virden, USN
Assistant Chief of Naval Operations (Communications)/Director, Naval Communications



Maj. Gen. Harold W. Grant, USAF
Director Communications-Electronics

"IT GIVES ME great pleasure at all times to bear testimony to the efficiency of the Army Signal Corps, particularly to the skill and attention to duty of its members who have been stationed . . . under my immediate eye"

These words of Admiral Farragut after the Battle of Mobile Bay nearly 100 years ago are as dynamic today as they were in the infant days of the gallant Army Signal Corps which is celebrating its first centennial.

The torch and crossed flags insignia coupled to the Corps motto *Pro-Patria Vigilans* attest to the intellectual attributes and sense of duty of the men and women of the Corps who have been "Vigilant for our Country" since June 21, 1860.

That day would hold no particular significance for the U.S. Army or for us of AFCEA, and, in fact, AFCEA itself might not have come into existence at all, had not an American Army officer been authorized as Signal Officer of the United States Army

(Continued on page 8)

THE CENTENNIAL of the Signal Corps is a most auspicious time to pay our respects to this distinguished ancestor of the United States Air Force.

From the courier on horseback to modern combat communications represents a century of accelerating progress. The Signal Corps, exploiting the advances of science throughout the years, pioneering with its own research, and pointing the way for others, has forged steadily ahead. From the semaphore and heliograph to this day of satellites and single sideband, the work of the Signal Corps has enhanced the effectiveness of the nation's Armed Forces.

In looking back over this first hundred years, we recall with understanding and appreciation the efforts of the men who were responsible for these achievements.

With each new advance in the arts and sciences of communication, these dedicated men worked out their most useful military applications. They worked, often under handicaps, to-

(Continued on page 9)

Admiral Virden's statement continued ★ ★ ★ ★

on that date and the distinguished leadership initiated which ultimately led to the establishment of the U.S. Army Signal Corps in March 1863.

Ever since the appointment of Major Albert J. Myer as the Army's first Signal officer, the Army and the Navy have liberally shared the benefits to be derived from each other as applicable and advantageous to the common National interest.

For example, the Naval Academy signaling classes incorporated wigwag sometime prior to 1863, and even before this date some U.S. Naval personnel were instructed in this Army method of signaling invented by Major Myer and taught at Myer's schools.

In the conflict with Spain in 1898, and in all subsequent wars, our Army and Navy fought together in the Atlantic and Pacific. After the Battle of Manila Bay the Army ashore at Manila signaled its positions to the guns of Admiral Dewey's fleet and spotted the fall of shot for the Naval guns that bombarded the enemy's forts ahead of advancing American troops.

The mutual material and technical assistance exchanged between Army and Navy communications has been a fine example of inter-service cooperation. Evidence of this can be seen in many of the present day operating spaces of communication installations. Particularly valuable in World War II were the family of frequency modulated portable radio sets and the field telephone equipments for which both the Navy and Marine Corps have cause to remember the Signal Corps with a "Well Done."

The Marine Corps is also appreciative of the training its officers and men have received from the Signal Corps and for various Signal Corps-developed equipments it has used in many campaigns following World War I.

Since "Korea" cooperation between the Army and Navy, including the Marine Corps, has been further strengthened by mutual participation in various unified commands and by increasing operational cross servicing.

It was the writer's privilege to serve with Signal Corps officers and enlisted personnel, as well as members of the Air Force and Navy, while on the staff of Commander-in-Chief Europe (CINCEUR). Daily service contact with these officers of the staff, and official visits to Army communications stations in France, Germany, Italy, Turkey, and Africa, stimulated my esteem for the Signal Corps' technical competence and operational performance.

The over-all contributions of the Signal Corps to communications and other scientific progress are considerable.

The Corps inaugurated the U.S. Weather Service, now the U.S. Weather Bureau, and operated it for more than two decades.

Since 1898, the Corps has been responsible for Army photography.

The Corps' Aeronautical Division, established a decade before the United States entered World War I, remained a part of the Signal Corps until the Army Air Corps was formed in 1918.

The Army's first electrical communication device was the hand-powered Beardslee magneto electric telegraph set developed under the supervision of Major Myer. Since this "Flying Telegraph" of those early years, the Signal Corps has introduced innumerable new types of field radio, aircraft radio and fire control devices.

While he was chief of the Signal Corps' research and development activity, the famed Dr. Robert A. Millikin authored many designs, including several improvements for radio vacuum tubes. The Signal Corps' Major Edwin H. Armstrong developed the superheterodyne circuit and later contributed substantially to the frequency modulation radio technique.

Today, Army Signal Corps Weapons System development is a vital element of the ground forces' role in the National defense. Among the principal achievements in this field are lightweight telephones; radio and teletypewriter field equipments utilizing micro-miniaturization mobile radio switching centers; target surveillance and acquisition equipments which include a telecasting television system which can be manpacked in the field, and advanced sensors of greatly improved resolution and discrimination.

The Corps will initiate automatic data processing into the ranks of new Army mobile equipments when the Army's first MOBIDIC sets are delivered this year.

The Signal Corps has also been a pioneer in providing support for the electronic control and coordination of NIKE and HAWK missile batteries.

At the Signal Corps Radar Laboratory, Camp Evans, Belmar, N. J., Army radio in 1946 established man's first radar contact with the moon. This research program was continued as Project DIANA. Somewhat later, the Corps initiated a space communications program leading to Project SCORE which was successful in broadcasting from outer space the President's 1958 Christmas message.

Well known to AFCEANS is the Army-developed solar cell, a 'first' in space science. For more than two years, Army solar cells have been powering a radio in Vanguard I, the Navy's satellite launched into space in 1958 and expected to orbit up to 1,000 years. They are making it possible for Vanguard I's radio to pass significant scientific knowledge. For example, Vanguard I's solar-powered radio transmitted the satellite's discovery of the pear shape and oblateness of the earth, and has taught us that the earth's outer atmosphere is six times more dense than had been believed, and that the earth's outer atmosphere changes with solar activity. Vanguard I's continued radio transmissions have proven the value of the solar cell itself by dramatically

demonstrating its longevity and usefulness in space, which is a lesson in itself. All evidence indicates that the solar cell units will function through the many centuries that Vanguard I is expected to live.

The Signal Corps' accomplishments in meteorology by satellite photography of cloud cover in conjunction with Navy studies of rocket photography initiated a new technique for weather forecasting and storm detection. This combined capability recently won deserved national recognition from the success of TIROS, a successful NASA project based on Signal Corps research and development of satellite instrumentation for meteorological purposes.

The Army Signal Corps owes its success to its vigorous leadership and to the technical competence and resourcefulness of its personnel. Navy and Marine Corps Communicators congratulate and salute the Signal Corps on its centennial and wish it good luck and a fair breeze in its pursuit of the common objectives of the National Defense team.

General Grant's statement continued ★ ★ ★ ★

ward the goal of faster and more reliable communications between all elements of the Army's strength. Their work was to move information, which is the material of decision and command, and to move decisions and commands in turn, under any and all conditions of war and peace.

They did their work well. They succeeded, often in the face of formidable odds.

Nor can we forget the part played by the Signalmen in pushing back the American frontier. Military telegraph lines, including submarine cables, were our first national communications net, and it included, prophetically, the then Territory of Alaska.

It was the Signal Corps which began the compilation of weather observations, for military and for civilian use. The Corps extended this even to observations for polar expeditions for many years, until the responsibility for civilian weather observation was established in a separate agency.

The seeds of modern airpower were first sown in the Signal Corps. It was here that the applications of airpower to military use were first tested. Reconnaissance led the way, quickly followed by bombing and aerial combat. What has happened since those first, tentative experiments has been, by and large, refinement of the basic ideas.

We must admit that the refinements have been so extensive as to create entire new dimensions of military thought. General Billy Mitchell was the prophet of the idea that an aircraft becomes obsolete the minute you begin to build it. The years that have passed since he expressed this view have repeatedly underscored the fact that he was right. With the extension of aircraft ranges, altitudes, and speeds, we soon came to the point where communications and aircraft movement control were clearly integral to flight itself.

The need for parallel progress in flight and communications was pointed up by a pioneering flight to Alaska, led by General "Hap" Arnold in 1934. Ground stations were set up along the planned flight path, and the B-10 bombers maintained ground contact throughout their trip. Though successful to that extent, the flight revealed the need for far more, and far better communications in general. On his return from this flight, General Arnold laid down a series of requirements which resulted, four years later, in the establishment of the Army Airways Communication Service.

This first AACS, operating as an independent progeny of the Signal Corps, was the first military communications network designed for the specific purpose of aircraft movement support.

It also became the nucleus of all Air Force communications when the air arm became autonomous in 1947. The network then began to accept administrative and logistic traffic in addition to its normal function, and handled it well until more adequate facilities could be placed in operation.

Meanwhile, back in the laboratories, and on the drawing boards, nothing was standing still. Higher speeds with jet aircraft, longer ranges through aerial refueling, and higher service ceilings were in prospect, all spelling out new requirements for improved communications.

Today we are in the era of Mach 3 aircraft and Mach 10 intercontinental ballistic missiles. The existence of such weapon systems places a premium upon unprecedented radar capabilities and upon speed and accuracy of data transmission, data reduction and display. Command and control communications, integrated with weapons of such impressive characteristics, call for reliability standards within decimal points of perfection.

Furthermore, our demands are increased by the deployment of American airpower to many parts of the earth, as well as the need for communication with our allies of many nations. All these factors have contributed to the multiplication of communications channels and techniques, and at the same time have established ever higher requirements for reliability and security.

The end is certainly not in sight, if one even exists.

Tomorrow's problems are already upon us. The MIDAS satellites for early warning of missile attack, and the SAMOS reconnaissance satellites are not mere extensions of existing systems. They are the pioneering steps of the military missions in space, to which we must logically extend our deterrent power. The demands of these new systems in terms of efficiency and reliability are apparent.

Such have been the changes in Air Force communications and electronics within three decades, since communications and flight became integral to each other. The growth of both sciences has been swift but sound. They look confidently to the future. And, from its position of relative youth, the Air Force is proud to salute the Army Signal Corps, now entering its second century of service to the nation.

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a century of u.s. army signals

1860-1960

U.S. ARMY SIGNAL CORPS

BRIGADIER GENERAL ALBERT J. MYER
FIRST CHIEF SIGNAL OFFICER OF THE U. S. ARMY

MARKING ONE HUNDRED YEARS of Army signals on 21 June 1960, the U. S. Army Signal Corps celebrates a century of service to the Army and the Nation.

From colored signaling flags to a communications satellite relaying voice and teletype messages in outer space, it's a unique record: the first independent signaling organization of the military, the first such organization to support the Army in wartime, and the first of its kind in many other respects. The Corps has been responsible for civilian as well as military communications advances.

The founding of the Signal Corps as a separate branch is attributable to an Army surgeon, Major Albert J. Myer, whose interest in helping the deaf led to a system of sign language between military outposts.

Authorized as Signal Officer of the Army on 21 June 1860, Major Myer filled a unique position as director of the first full-time signaling function of a national army.

At once he began to build a corps of signalmen whose services during the Civil War proved so invaluable that a formal U. S. Army Signal Corps was established in March of 1863. The orange color distinguished by the historic Army Dragoons became the branch color of the new Signal Corps. The new Corps was to serve as both a combat arm and a technical service, a dual role continued to this day.

Major Myer's signalmen employed the wigwag flag by day and torches by night, waving them in a code system, watching and reading through telescopes between companion stations.

Major Myer also had ideas of putting the electric telegraph into the field service of the Army. Civilian telegraphers, directly controlled by Secretary of War Stanton and paid by the Quartermaster, were employed from the start of the war in the military effort of the North. This was the U. S. Military Telegraph, which provided command and administrative communications between major headquarters.

But Major Myer wanted tactical electric telegraph which could be moved about for free employment in the field, when visual signals could not be used. Working with civilian inventors, he brought about the development of Army's first electrical communication device, the Beardslee magneto-electric telegraph set. Hand-operated (without batteries) and readily portable, it could signal over several miles of insulated field wire which soldiers laid rapidly over the ground or strung on lance poles. They called it the "Flying Telegraph."

Assisted by officers and men detailed to him, Major Myer provided more and more military communications as the Civil War developed. Visual signals figured prominently in amphibious actions along the southern coasts; at Bull Run, Gettysburg, Altoona; and in the assaults on Richmond, in 1862 and in 1864-65. The Beardslee magneto-electric telegraph and the "Flying Telegraph Trains" played a part in the Peninsular Campaign and at Fredericksburg in 1862.

Captive military balloons, a logical uplifting of elevated observation and signal platforms, were not an Army Signal Corps assignment in the Civil War. In mid-1863 the Army offered its rather uncertain balloon activity to the Signal Corps, and Col. Myer refused it on the grounds that he did not have enough men or money. So the Army dropped balloon operations altogether until 1892 when aeronautics and military ballooning were resumed—a responsibility of the Army Signal Corps.

After the Civil War and Secretary Stanton's departure, the War Department restored Col. Myer as the Chief Signal Officer. In 1867 he gained control over the command and operation of all Army telegraph lines—including lines linking isolated camps and posts. The Corps built and maintained increasingly longer wire lines operated by key and sounder using battery-powered current. Corps also provided "Flying Telegraph Trains" to each Army Corps.

As the nation pushed deeper into western territories and as Army outposts sprang up in Indian country, the Army Signal Corps erected more telegraph lines, reaching a peak of about 5,000 miles of lines by 1880.

Meanwhile a most unusual assignment had come to the Corps. Congress in 1870 authorized a national weather service and assigned it to the War Department, whose Army Signal Corps telegraphers at outlying posts offered a ready and inexpensive means of simultaneous weather reporting from coast to coast. The weather service of the Corps grew rapidly, soon comprising hundreds of reporting stations from the Atlantic to the Pacific and in adjoining areas of Canada and the Caribbean. Regular weather reports and storm warnings became a popular and demanded routine, and included exchange of weather data with foreign nations and the beginning of international cooperation in large-scale scientific efforts.

After the death of General Myer in 1880, the Army Signal Corps under Brig. Gen. William B. Hazen participated in the First Polar Year, an international effort to learn more about the Arctic. This cooperative endeavor constituted what was in fact the first geophysical year.

In 1881 Hazen sent out two expeditions, one to Point Barrow, Alaska, the other to Lady Franklin Bay on Ellesmere Island, opposite northern Greenland. The ten men of the Point Barrow party returned safely in 1883 with a complete set of scientific observations during the Polar Year.

The 25 men of the Ellesmere Island team under Lt. A. W. Greely likewise maintained regular records of weather and polar phenomena and explored hitherto unknown areas in the vicinity. A party under Lt. J. B. Lockwood in 1882 reached the point furthest north attained by white men to that date. But the southward return of Greely's group met tragedy. Navy ships intended to pick them up were blocked by ice packs in the Greenland channel

for two successive summers. Not until 1884 did a rescue ship get through, to find only seven survivors, the others having starved to death. All the scientific records were saved.

Upon the death of Gen. Hazen in 1887, Greely, then a captain, world renowned for his Arctic service, was promoted to brigadier general and Chief Signal Officer. With his scientific bent of mind and vigorous support of military communications and innovations, he kept the Army Signal Corps intact during a decade of effort to disband the Corps, especially after Congress decided that the weather service was too civilian in character to remain in the Army. The Department of Agriculture took over this service as the Weather Bureau in 1891.

Meanwhile new modes of communication had come to the Army—the heliograph and the telephone. Immediately after the loss of the weather function, the Army resumed interest in military balloons. In 1892, Gen. Greely won War Department consent for the assignment of this responsibility to the Signal Corps.

Greely also promoted military uses of photography, having taken Army's first photographer, Sgt. George W. Rice, to the Arctic in 1881-84. His photographs, though he himself was among those who starved to death early in 1884, were all preserved.

By 1898 and the Spanish-American War, Greely was budgeting for photography and providing photographic services to the Army. In that war, the Army Signal Corps provided telephones as well as telegraph lines on the combat front in Cuba. The Corps' one balloon did duty during the assault on San Juan Hill.

Similarly in the Philippines in 1898, Signal Corpsmen brought up wire communications in the assault on Manila and coordinated by means of wigwag the fire of Navy's warships in Manila Bay.

Following that war the Corps installed extensive wire lines both in Cuba (also in Puerto Rico) and in the Philippines. In the latter area a great deal of underseas cable was also laid to link up the major islands.

In 1900 Congress assigned to the Army Signal Corps responsibility for communications to and in Alaska—cable and wire lines serving not only military garrisons there but all civilian needs as well—to the benefit of mining and fishing interests and other settlements scattered throughout the Territory. Radio, or wireless telegraphy, was introduced in 1898 into the Army by the Signal Corps. One of the first military circuits employing this new technology was a 100-mile link across Norton Sound to Nome, Alaska, obviating a difficult land line or underwater cable route to that outlying settlement.

In 1906, Gen. Greely concluded his long service, nearly 19 years as Chief Siganl Officer. There fell to his successor, Brig. Gen. James Allen, the task of introducing airplanes to the Army.

The success of the Wright airplane in 1903 led to the formation of the Aeronautical Division in the Signal Corps in 1907—and a contract with the Wright brothers for an airplane to meet Army specifications. The plane made its initial flight at Ft. Myer, Virginia, on 3 September. In the course of subsequent flight tests, this airplane crashed on 17 September, severely hurting the pilot, Orville Wright, and fatally injuring his passenger, 1st Lt. Thomas E. Selfridge, a Field Artillery officer on duty with the Army Signal Corps for aviation service—the first man ever to die in heavier-than-air powered aircraft.

In 1913, Brig. Gen. G. P. Scriven, Allen's successor, inherited an expanding variety of Army Signal Corps activities. These included field radios, aircraft radios, increasingly elaborate long-range wire, cable and radio circuits, and fire control systems for directing the fire of large guns on targets visible only to remote observers. A month before the United States entered World War I in 1917, Brig. Gen. G. O. Squier became the Chief Signal Officer.

Squier built up the Corps tremendously, from fewer than 2,000 officers and men to over 50,000 by the close of 1918. A permanent Army Signal Corps post at Ft. Monmouth, New Jersey, was begun as Camp Alfred Vail and centered on a nucleus of signal schools and laboratories.

Squier induced the world-renowned physicist, Dr. Robert A. Millikan, to come from the University of Chicago to head Army Signal Corps research and development activity. Many new kinds of equipment, particularly vacuum tube radios, were designed and produced by industry.

In France the outpost companies of field signal battalions provided all telephone, telegraph and radio service down to the barbed wire, while signal telegraph battalions built heavy-duty communication lines across the country. In Paris the Signal Corps maintained a laboratory in which worked such scientists as Maj. Edwin H. Armstrong, who developed the superheterodyne circuit during his overseas service, and who later invented frequency modulated radio. One of the scientist-officers whom Gen. Squier brought into the Corps was Maj. William R. Balir who was placed in charge of the considerable meteorological activity maintained by the Army Signal Corps in France to serve the needs of fire control and aviation.

U. S. Army aircraft continued as a Corps' responsibility until the War Department took aviation out of the Signal Corps in May, 1918, setting it up as the Air Service—which later became the Army Air Corps.

Army photography became an increasingly important Army Signal Corps' function during World War I, expanding to include motion pictures and training films so necessary to train large numbers of recruits quickly.

During the decade of inevitable military shrinkage after World War I and the ensuing decade of the depression, one Chief Signal Officer after another, Maj. Gens. C. M. Saltzman, G. S. Gibbs, I. J. Carr, J. B. Allison, and J. O. Mauborgne, struggled to maintain, against oppressive shortages of money and men, a skeletal Signal Corps. They promoted new developments in wire and radio, and brought out a steadily improving series of SCR (Signal Corps Radio) numbered sets of ground and airborne radios. They improved the War Department Radio Net and Army communication links within the continent and beyond—to such outlying posts as Hawaii and Panama.

Gen. Mauborgne, a research-minded chief, especially supported the highly secret beginnings of Army radar, which Col. Blair, Director of the Army Signal Corps Laboratories at Ft. Monmouth since 1930, had initiated. Col. William R. Blair holds the fundamental and basic patent for American radar. From the Signal Corps' pioneering in the development of our country's radar have evolved the many radars used in the military and those employed in numerous civilian applications such as navigation, storm tracking and air lines flight direction and control.

In the years immediately before America plunged into World War II, the Signal Corps promoted Dr. Armstrong's newest contribution to radio, frequency modulation, which soon revolutionized mobile communications in Army combat.

Maj. Gen. D. Olmstead succeeded Mauborgne a few months before the attack on Pearl Harbor, an occasion when the Army Signal Corps' radar SCR-270 on the north shore of Oahu performed properly, detected the Japanese airplanes 130 miles away, and gave the warning which men would not believe.

At once Olmstead received a superhuman task of expansion which paled the rapid growth of the Corps in the previous World War, not so much in manpower as in research, development, and production. While the Corps leaped from 27,500 to 350,000 officers and men in four years, enormous and increasingly intricate growth occurred in the research, development, and supply of equipment, in the training of men in the applications of new electronic devices and weapons previously unheard of: complex radios in every tank and command car (push-button FM radio), mobile long-range radio, radio relay, carrier communications, radio-teletype employed in the new world-wide system of ACAN (Army Command and Administrative Net), and radar.

Radar alone soon equaled the great variety of radio and wire items in the many forms in which this new technique developed — radars both for

ground troops and for the explosively expanding Army Air Corps. Under Maj. Gen. H. C. Ingles, Chief Signal Officer, 1943-1947, the Army Signal Corps emerged from the four-year ordeal much larger and with far wider activities and responsibilities than ever before. This was true despite the fact that the Corps lost to the Army Air Corps late in 1944 all electronics responsibility for aviation, and lost late in 1945 all radio intelligence activity. This last, a specialized application of communication-electronics, had greatly expanded during World War II. Though these losses momentarily cut away from the Corps nearly half its men and activity, within a few years the Signal Corps' assumption of new and important missions regained and enlarged its stature in the Army.

For a while after World War II the personnel of the Corps declined, reaching a low of about 50,000 in early 1950. Its schooling tasks which had mushroomed during the war to include Camp Murphy in Florida and Camp Kohler in California were reduced to the basic schools at Monmouth. But the communication-electronics sciences could not be permitted to lapse. These fields were increasing dramatically in importance. The several laboratories which had spread out in the Monmouth area since the 1940's began by 1954 to consolidate in one huge hexagonal building, the present U. S. Army Signal Research and Development Laboratory at Ft. Monmouth.

The fact that significant research and development did not greatly decline was exemplified by man's first contact with the moon, accomplished by Army radar at the Signal Corps Radar Laboratory, Camp Evans, Belmar, N. J.

In 1946, this proved the feasibility and marked the beginning of space communications in which the Corps continued to pioneer, culminating in SCORE — the Army-developed signal communications relay equipment — which radioed President Eisenhower's Christmas message to the world from outer space in 1958.

Under Maj. Gen. S. B. Akin, Chief Signal Officer, 1947-51, the special skills and technologies of the Signal Corps were maintained. The worldwide communications of the Army Command and Administrative Network (ACAN) continued to improve the services required by Army and government personnel in many overseas locations. Radio-relay techniques were improved and the equipment received ever wider use. It was the radio-relay teams of the Signal Corps on occupation duty in Japan that suddenly found themselves in June, 1950, called upon to support a conflict in a new sort of war in a new setting, supporting the United Nations in Korea. The first Army troops and the first casualties in that land included Signal Corpsmen flown in from Japan.

Korean combat placed new requirements on the Signal Corps. The renewed use of aircraft in the Army, including helicopters, demanded special communications and navigation equipment. Ground forces demanded new and better ground radar—mortar locators and troop detectors particularly. Again the Corps underwent wartime expansion, under Maj. Gen. G. I. Back, 1951-55.

New schools were required at San Luis Obispo in California and at Camp Gordon in Georgia to supplement the Army Signal School at Ft. Monmouth. The Fort Gordon School continues today as an essential Signal training installation, the U. S. Army Signal Training Center, which includes the Southeastern Signal School.

In the years since the Korean War and especially under Lt. Gen. J. D. O'Connell, 1955-59—the first Chief Signal Officer to receive the rank of lieutenant general—there was a tremendous rise in communications-electronics.

Electronic support for guided missiles began in 1949 at the Army's White Sands Missile Range in New Mexico and soon grew into the large U. S. Army Signal Missile Support Agency. The experience and early participation in this phase of communications-electronics work was to permit the Army Signal Corps to provide major science and electronics support to subsequent missile and space programs.

Electronic warfare and countermeasures efforts which began modestly at Ft. Monmouth in 1950 quickly expanded by 1954 into significant developments at Ft. Huachuca, Arizona, where the Army Signal Corps now operates the U. S. Army Electronic Proving Ground. Here important test and evaluation work is carried out on newly developed Signal Corps' equipment and systems under simulated and actual field conditions.

Phenomenal growth in recent years —accelerated by the missile and space era — has characterized numbers of other major Signal Corps' efforts. For the nation's air defense, MISSILE MASTER, an electronic control and coordination system for use with NIKE and HAWK missile batteries, was developed by the Corps and industry. The first operational system was put into action at Ft. Meade, Maryland in December of 1957. Additional systems to perform this vital electronic air defense mission are being installed at key complexes throughout the United States.

The advent and rapid development of Army Missiles brought forth a relatively new and expanding electronics mission area for the Signal Corps— that of combat surveillance and target acquisition—essentially, gathering information day and night, in all weather, about the enemy for employment of weapons systems against him.

The U. S. Army Combat Surveillance Agency was established to provide direction for this major systems area. The Corps developed and introduced on an expedited basis a number of surveillance equipments—a few of these modified versions of existing off-the-shelf type items. Among these new equipments were first generation pilotless surveillance drones; the man-packed TELESCOUT television system; mobile and portable surveillance radars, one weighing only 80 pounds; and sensors such as airborne radars, infra-red and photographic cameras. Development continues toward improved systems utilizing a variety of means—radar, photography, infra-red, TV, seismic and acoustic—some to be carried in advanced surveillance drone vehicles and manned Army aircraft.

Significant advances were made in avionics, involving electronic devices and communication for Army aircraft. Besides communication sets, a mobile control tower was developed. The Corps is developing in a joint program with the Navy, an instrumented flight system for helicopters and fixed-wing aircraft, with real picture presentation to the pilot. Also in progress are navigational systems employing visual map presentation to show the pilot the in-flight location of his plane.

Automatic data processing, added to the world-wide ACAN system in 1955, is being directed to tactical communications; and militarized equipments for use in the field army are under development. The first model of MOBIDIC, a large mobile all-purpose computer, will be delivered to the Signal Corps this year. These and other advances in elaborate tactical communications, including a tiny belt-pack or helmet radio carried by an individual soldier, made possible by micro-miniaturization techniques; mobile and air-transportable long-range communications central for STRAC-type missions; and satellite communications have revolutionized once again the art of military signaling founded by Major Myer a hundred years ago.

Besides the "talking satellite" of Project SCORE, which first actively relayed voice and teletypewriter signals through outer space, the Army Signal Corps developed the solar cell conversion for powering satellite radios—initially used on VANGUARD I, launched March 17, 1958. This satellite, the first in the world known to use solar energy for its radios, is still transmitting after more than a year in orbit. A more complex solar ring was designed and constructed by the Army Signal Research and Development Laboratory for EXPLORER VII, which went into orbit in October of 1959.

The Corps also helped to carry meteorology into space. A unique type of Signal Corps satellite instrumentation —the cloud cover or weather experiment—was placed in orbit February 17, 1959. Although spin problems of the satellite prevented obtaining successfully the cloud cover photos intended, the experiment was an initial step in using satellites for cloud cover study and related forecasting and storm detection. Future satellites of this type are planned, such as TIROS under the National Space Aeronautics Adminis-

tration. (Editor's note: TIROS I has been launched since the writing of this article.)

Under the eighteenth Chief Signal Officer of the Army, Maj. Gen. R. T. Nelson, appointed May 1, 1959, the Army Signal Corps continues to seek improved command control systems of communication, combat surveillance, electronic warfare, and avionics for the Army, and to contribute to the electronic science and capability of America's space effort.

Among promising equipments and systems under advanced development are a mobile radio switching central carried in an Army vehicle which handles up to 48 radio subscriber sets in jeeps much the same as a telephone switchboard, intended primarily for battle group use; a push-button telephone to replace the conventional dial type; smaller and lighter miniaturized telephone, teletypewriter and radio equipment for combat, including a four-wire telephone system that features a mobile electronic telephone switchboard; jet surveillance drones and advanced sensors of greatly improved resolution and discrimination; small tactical ADPS equipment, involving a minimum tactical computer weighing no more than 175 pounds; and a mobile decision-making complex for the commander called a Tactical Operations Central, in which visual displays of information and communications means will be centralized. For the control and coordination of NIKE and HAWK missiles in the combat air defense of field armies, MISSILE MONITOR, now tested and accepted, is already being deployed.

UNICOM (Universal Integrated Communication System), a concept for a global communications system which will provide personalized service, high-speed automatic switching, and any mode of transmission such as video, data, facsimile, voice and records communications on a completely secure basis, is being pressed forward. With this system should come the use of communication satellites as repeaters —corollaries of the ground stations.

Among forthcoming communications satellites on which the Army Signal Corps is performing work is COURIER, the first phase of Project NOTUS. COURIER's purpose is to develop a prototype of a global communications network of communicating satellites.

From flags slowly spelling out words, military signaling has moved into electronics, for whose capabilities words and human speech are much too slow. In the lightning fast future of electronic computing machines and of electronic signals which, at speeds measured in millions of bits of data per second, flash to the ends of the earth and far beyond through the infinity of space—in this future the U. S. Army Signal Corps' wigwag flag and flaming torch become the symbol for the new era of communications-electronics of the United States Army.

SIGNAL CORPS CONGRESSIONAL MEDAL OF HONOR WINNERS

MORGAN D. LANE

Rank and Organization: Private, Signal Corps, United States Army. *Place and Date:* Near Jetersville, Va., 6 April 1865. *Birth:* Monroe, New York. *Date of Issue:* 16 March 1866. *Citation:* Capture of flag of gunboat *Nansemond*.

WILLIAM C. BARNES

Rank and Organization: Private First Class, Signal Corps, United States Army. *Place and Date:* At Fort Apache, Arizona, 11 September 1881. *Entered Service at:* Washington, D. C. *Birth:* San Francisco, California. *Date of Issue:* 8 November 1882. *Citation:* Bravery in action.

CHARLES E. KILBOURNE

Rank and Organization: First Lieutenant, United States Volunteer Signal Corps. *Place and Date:* At Paco Bridge, Philippine Islands, 5 February 1899. *Entered Service at:* Portland, Oregon. *Birth:* Fort Myer, Virginia. *Date of Issue:* 6 May 1905. *Citation:* Within a range of 250 yards of the enemy and in the face of a rapid fire climbed a telegraph pole at the east end of the bridge and in full view of the enemy coolly and carefully repaired a broken telegraph wire, thereby reestablishing telegraphic communication to the front.

GORDON JOHNSTON

Rank and Organization: First Lieutenant, United States Signal Corps. *Place and Date:* At Mount Bud-Dajo, Jolo, Philippine Islands, 7 March 1906. *Entered Service at:* Birmingham, Alabama. *Birth:* Charlotte, North Carolina. *Date of Issue:* Unknown. *Citation:* Voluntarily took part in and was dangerously wounded during an assault on the enemy's works.

ADOLPHUS W. GREELY

Rank and Organization: Major General, United States Army, retired. *Entered Service at:* Louisiana. *Birth:* Newburyport, Massachusetts. *G. O. No.:* 3, W. D., 1935. Act of Congress, 21 March 1935. *Citation:* For his life of splendid public service, begun on 27 March 1844, having enlisted as a private in the United States Army on 26 July 1861, and by successive promotions was commissioned as major general 10 February 1906, and retired by operation of law on his sixty-fourth birthday.

FORMER
CHIEF SIGNAL OFFICERS U. S. ARMY

MAJ GEN GEORGE I. BACA
1951–1955

LT GEN JAMES L. O'CONNELL
1955–1959

MAJ GEN SPENCER B. AKIN
1947–1951

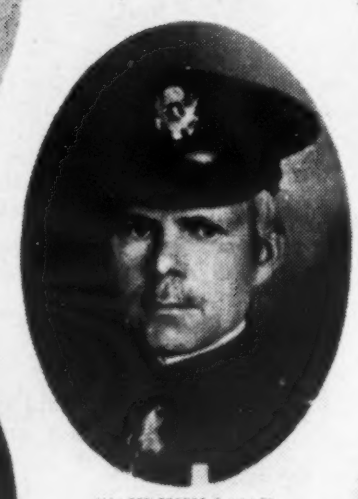
MAJ GEN HARRY C. INGLES
1943–1947

MAJ GEN DAWSON OLMSTEAD
1941–1943

MAJ GEN JOSEPH O. MAUBORGNE
1937–1941

MAJ GEN JAMES B. ALLISON
1935–1937

MAJ GEN IRVING J. CARR
1951–1954


MAJ GEN GEORGE O. SQUIER
1917–1923

MAJ GEN GEORGE S. GIBBS
1929–1931

BRIG GEN GEORGE P. SCRIVEN
1913–1917

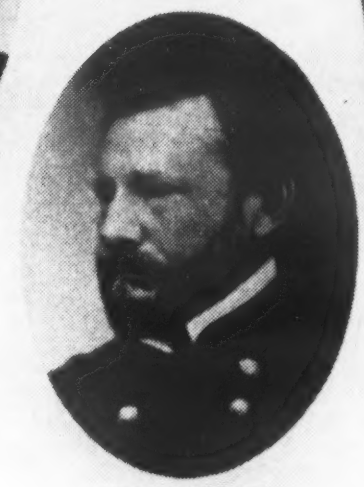
MAJ GEN CHARLES McK. SALTZMAN
1924–1929

BRIG GEN JAMES ALLEN
1906–1913

BRIG GEN ADOLPHUS W. GREELY
1887–1906

BRIG GEN WILLIAM B. HAZEN
1880–1887

COL BENJAMIN FRANKLIN FISHER
1884–1886


BRIG GEN ALBERT J. MYER
1860–1863
1866–1880

SB-22 Switchboard

GRC-19 Transceiver

Korean Civil Assistance Command

A TALENT FOR COMMUNICATIONS THROUGH TWO WORLD WARS

Stromberg-Carlson
a division of
General Dynamics
is proud to salute
the U. S. Army Signal Corps
on its 100th anniversary
and to have taken
a part in producing
communication equipments
which have served our
country in war and peace
. . . on this continent
and around the world.

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ROCHESTER 3, NEW YORK

METEOROLOGY: ARMY TELEGRAPH TO TIROS I

by

Lt. Col. Kenneth E. Shiflet, SigC

Office of Technical Liaison

Office of the Chief Signal Officer

FROM A REMOTE, and often beleaguered, telegraph station in Indian territory to the weather satellite TIROS I in space is a giant step in American meteorology.

Yet each—nearly a century apart in time—has common identity. Both served United States meteorology. And both represent *early* and *modern* ends of the scale of continuing U.S. Army Signal Corps contributions to that science.

TIROS I, launched as part of a program under the National Aeronautics and Space Administration, has performed most effectively as a forerunner to a possible network of orbiting weather satellites. Army Signal Corps participation in this NASA project marks experience in meteorological research and operations that extends over nearly all the one hundred years since the Corps' founding.

Authorized by Congress in 1870 to establish this country's first weather reporting and forecasting service, the Signal Corps used its network of Army telegraph stations to provide coast-to-coast operation. This domestic service was extended to weather data exchange with other countries —the beginning of international cooperation in important scientific programs. Although the civilian aspects of this national weather service were transferred to what is now the U.S. Weather Bureau, the Corps has continued to pioneer in military work for the Army. Interestingly enough, the Weather Bureau was one of the organizations with which the Signal Corps worked in the NASA TIROS experiment.

While the Army Signal Corps' basic mission is to provide communications, or more broadly—command control for the Army, it is also charged with other key responsibilities. One of these is meteorological research and development. This program concentrates primarily on the study of weather variations and data which occur over a relatively small area: local gusts of wind, differences in temperature and moisture between a plowed field and an adjacent field of corn, or the wind and temperature on a mountain top compared with that of the valley below. Tactical missiles have called for emphasis on related upper altitude experiment and research.

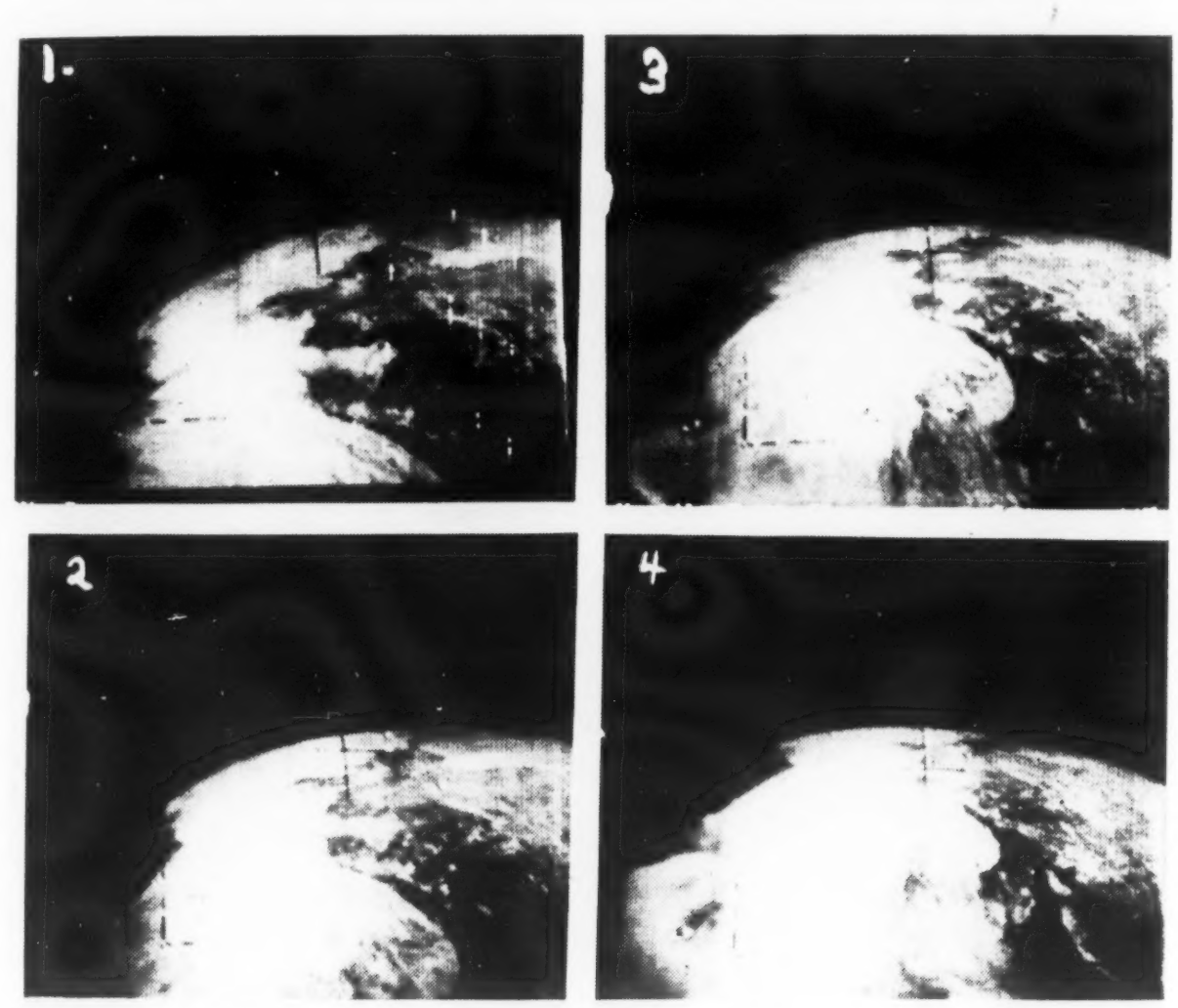


Fig. 1: Sequence series of photographs taken by Tiros I from a point several hundred miles east of the Atlantic Coast and from an altitude of about 450 statute miles. The photos were sent by television to receivers of the Army Signal Corps at Fort Monmouth, N. J., and then transmitted to NASA, which is conducting the Tiros project. The experiment is designed to study the use of space vehicles for weather observation. The white area shows the cloud mass that lies over the northeastern United States and Canada. The dark area at the bottom right is the Gulf of St. Lawrence. The photos were taken at intervals of less than a minute.

Army Signal Corps' meteorological skills are thus directed principally to weather tasks as they relate to combat operations. Yet weather has the distinction—if one could call it that —of affecting citizen and soldier alike. Most everyone tries to forecast for himself by glancing at the state of the sky. Weather conditions do not discriminate among those on whom they impose.

It is then not surprising that a very significant portion of Signal Corps effort in meteorology has also benefited the national civilian community. TIROS I, and the Corps' part in its development and operation under NASA, is a prime and recent illustration.

TIROS is the abbreviation for Television Infra-Red Observation Satellite. Although TIROS I does not have the infra-red sensing devices to map relative temperatures of the earth's

surface, a later satellite will have these sensors. TIROS I is a pay-off tribute to the scientists and engineers who produced it, launched it in near-perfect orbit, and made its weather picture relay work.

The two television cameras mounted in this weather satellite have made over 7,000 pictures of the earth's changing cloud cover. These cameras were developed for the Army Signal Corps by the Radio Corporation of America.

The large area camera, which gives about an 800-mile square view of the weather picture, is augmented by the second camera that pin-points smaller sections of cloud cover. They provide detailed pictures of hurricanes and cyclonic patterns. An early example of TIROS I's practical operation was the detection of a hurricane east of Brisbane, Australia. This information was later confirmed by the Australian Bureau, which had also detected the approaching hurricane and known about it. The consonance of the weather satellite's reporting underscored its capability and the potential of this type of U.S. satellite.

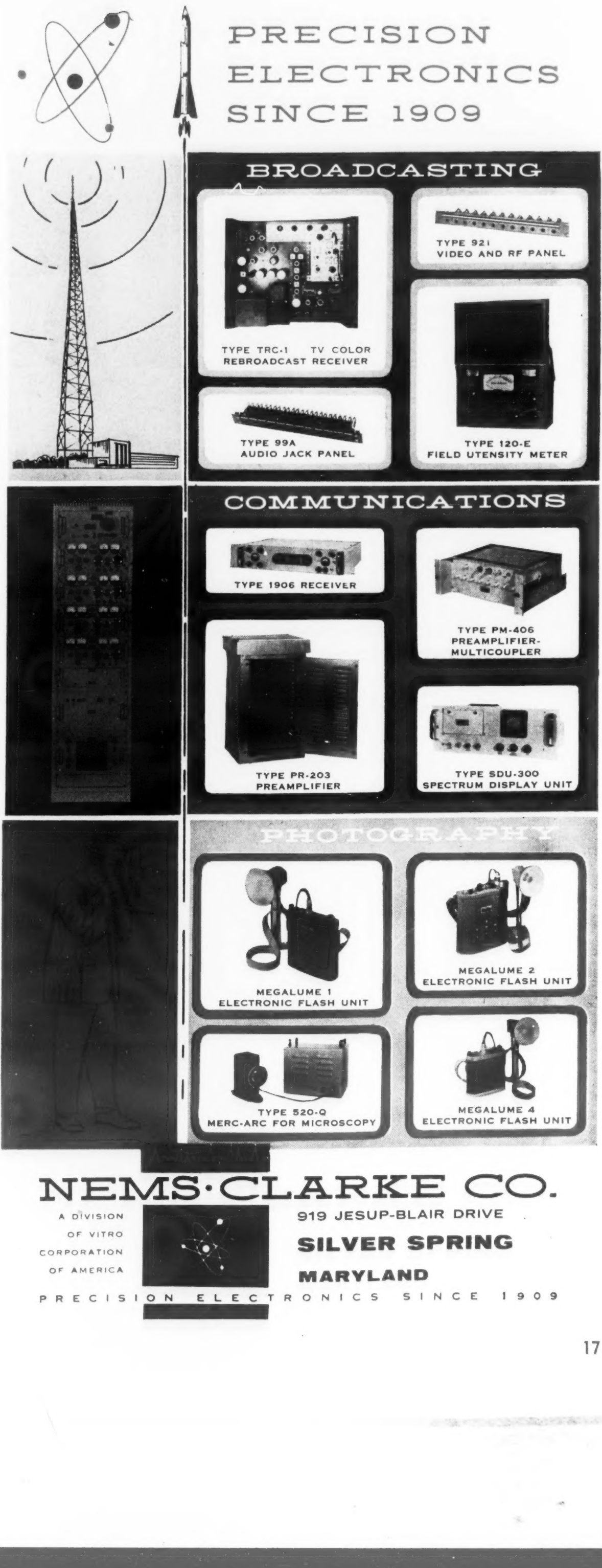
The resolution of the cameras is somewhat comparable to commercial television. Even individual cloud types, thunderstorms and tornado breeders may be shown in resultant pictures for weather study. An indication of the photographs obtained by TIROS I is evident in the accompanying pictures—some of the first the satellite acquired. (See Figures 1, 2 and 3.)

The pictorial information that is seen by the television cameras carried by TIROS I is stored on magnetic tape in the satellite. This data is transmitted, on radio command from the earth, to the ground stations in a manner similar to Project SCORE, the world's first communication satellite that was developed by the Army Signal Corps and RCA. Of course, TIROS I is "talking" picture reconstruction, while SCORE was sending or relaying voice and multiple teletypewriter signals.

The two basic ground stations in the TIROS project are located at Fort Monmouth tracking facilities, operated by the Army Signal Corps, and at Kaena Point, Hawaii, manned by the Lockheed Missile and Space Division and its consultant, Philco Corporation, under contract to the Air Force Ballistic Missile Division. Backup stations are at Hightstown, N. J. and Cape Canaveral, Fla.

When the satellite is in range, these ground stations can command TIROS

(*Continued on page* 20)



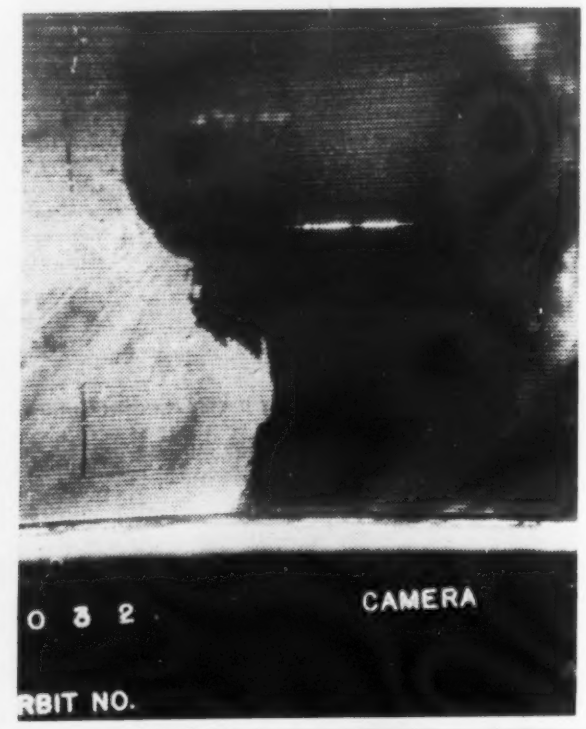


Figure 2: (top left)—The Kuril Islands stretching from the Russian Kamchatka Peninsula to the northern most Japanese Island of Hokkaido were recorded by Tiros I. Wide angle image of the Kuril Islands, recorded April 4, 1960 on the 36th orbit of the satellite, can be seen in the foreground. In the background is the mainland of the U.S.S.R. The image was received at the Kaena Point, Hawaii, station.

Figure 3: (top right)—The sharp definition of the western coast of French West Africa was recorded by the wide angle camera of Tiros I. Area of the picture extends from approximately Cape Blanco to St. Louis, French West Africa. The image was recorded on the 31st orbit of NASA'S Tiros I and was received at the Kaena Point, Hawaii, station April 4, 1960.

Figure 4: (middle)—The array of 9,200 solar cells covering the top and sides of the satellite are examined by Herbert Butler, center, Project Manager for the U. S. Army Signal Research and Development Laboratory, and Abraham Schnapf, left, and Barton Kreuser, right, of RCA Astro-Electronic Products Division.

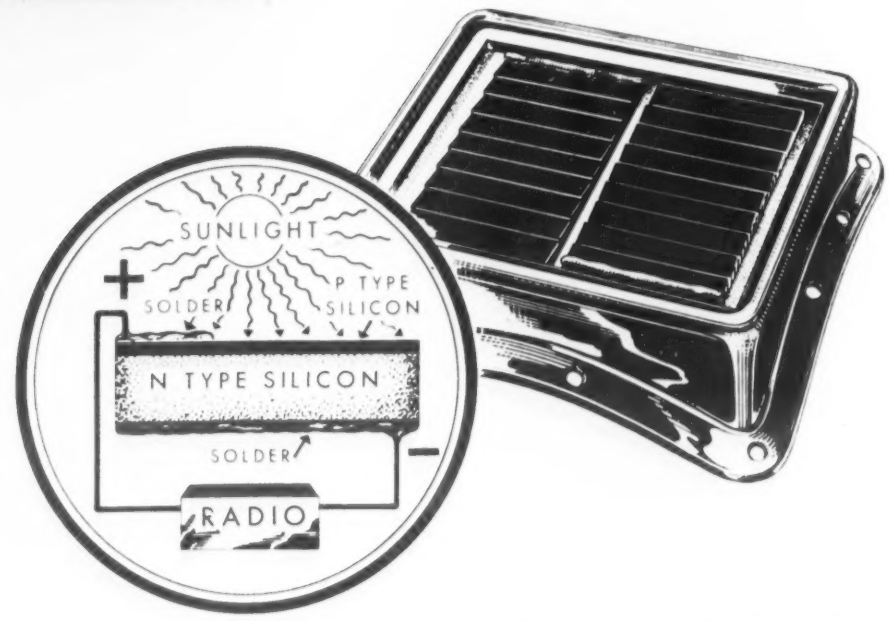
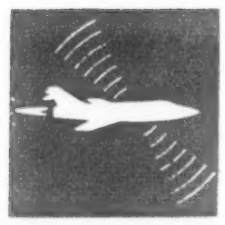


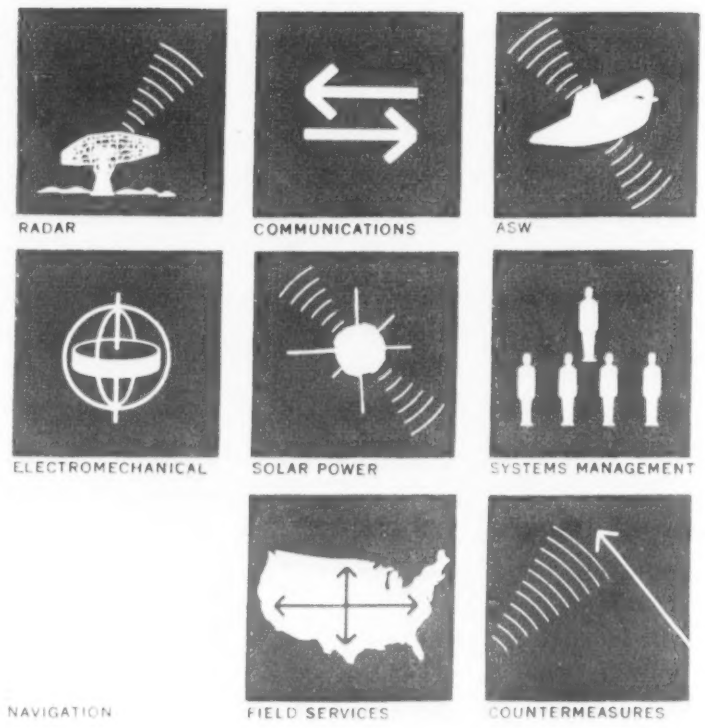
Figure 5: (bottom, left & right)—Vanguard I satellite, launched under Vanguard Program and solar converter developed by Army Signal Corps to power one of the radios carried by the satellite.

Hoffman

navigation problems?



Reliable navigation equipment is a must if a pilot is to reach his destination safely and on time. Hoffman, producer of the Air Force and Navy TACAN (Tactical Air Navigation) systems, has specialized in solving navigation problems for the United States military services since World War II. Hoffman has developed and built both the airborne portion of TACAN and specialized ground support equipment, as well as navigational computers and other inertial components. Hoffman's experience in the manufacture of navigation systems provides a capability-in-depth to assist you in solving your navigation problems.



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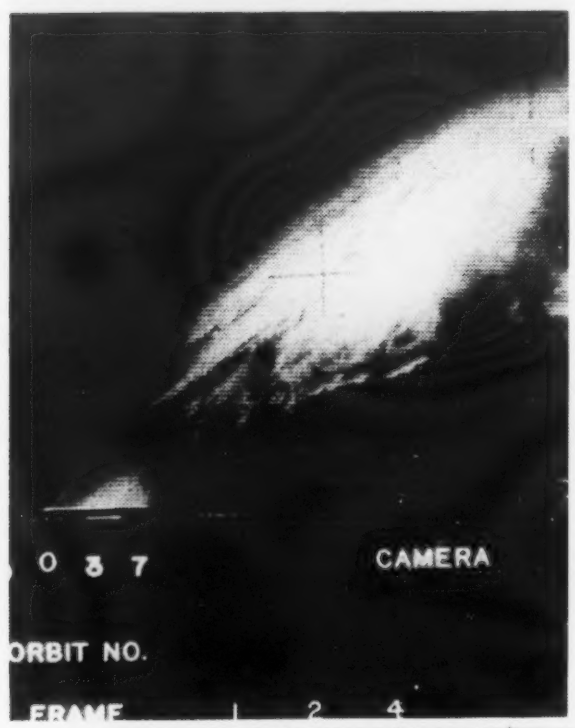

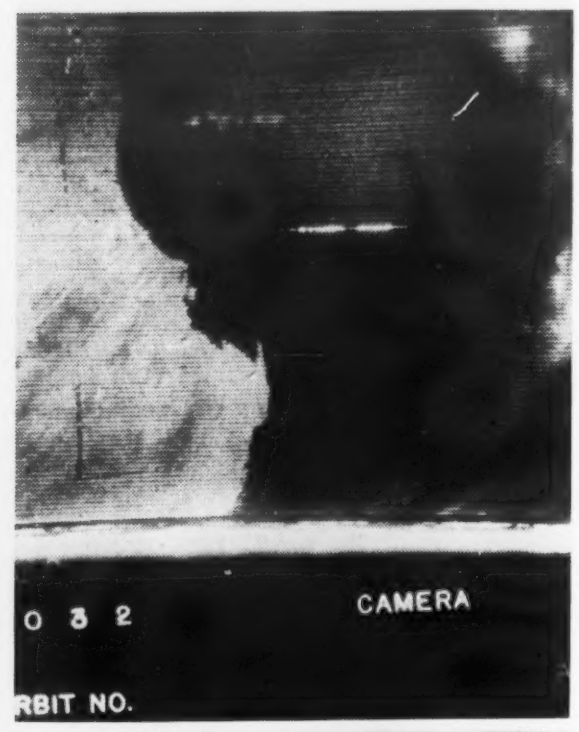

Figure 2: (top left)—The Kuril Islands stretching from the Russian Kamchatka Peninsula to the northern most Japanese Island of Hokkaido were recorded by Tiros I. Wide angle image of the Kuril Islands, recorded April 4, 1960 on the 36th orbit of the satellite, can be seen in the foreground. In the background is the mainland of the U.S.S.R. The image was received at the Kaena Point, Hawaii, station.

Figure 3: (top right)—The sharp definition of the western coast of French West Africa was recorded by the wide angle camera of Tiros I. Area of the picture extends from approximately Cape Blanco to St. Louis, French West Africa. The image was recorded on the 31st orbit of NASA'S Tiros I and was received at the Kaena Point, Hawaii, station April 4, 1960.

Figure 4: (middle)—The array of 9,200 solar cells covering the top and sides of the satellite are examined by Herbert Butler, center, Project Manager for the U. S. Army Signal Research and Development Laboratory, and Abraham Schnapf, left, and Barton Kreuser, right, of RCA Astro-Electronic Products Division.

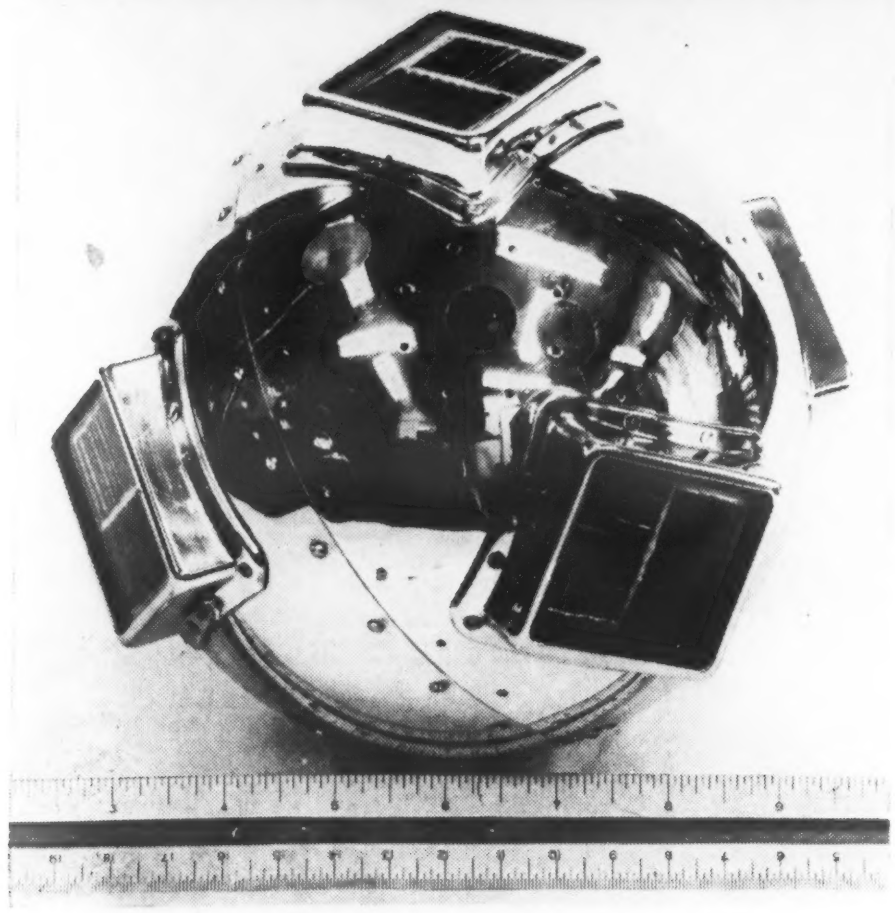

Figure 5: (bottom, left & right)—Vanguard I satellite, launched under Vanguard Program and solar converter developed by Army Signal Corps to power one of the radios carried by the satellite.

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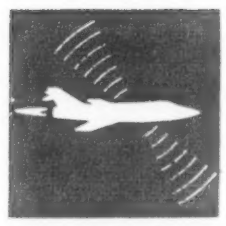
navigation problems?



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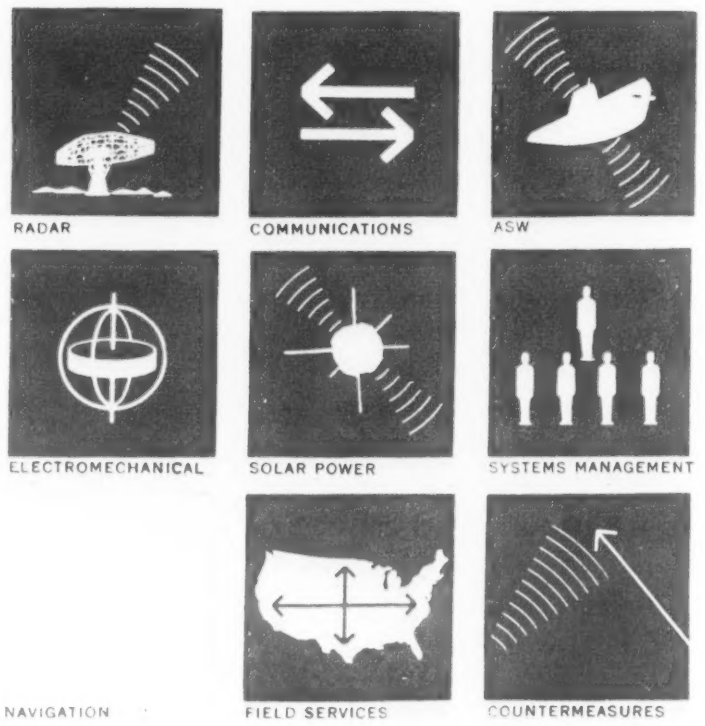

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(*Continued from page* 17)

I to transmit the TV picture of the moment directly to earth, without storing it on tape. This range normally consists of approximately 1,000 miles. The automatic direction of the satellite's picture operation allows a ground station to order transmission of a picture of the area of the ground station itself or the intervening cloud cover.

Cloud cover pictures are received and recorded on film and magnetic tape at the basic ground stations. Original films, such as those associated with the first pictures obtained at Fort Monmouth, are transmitted at once to Washington for analysis. Duplicates and tapes of these pictures can be converted to photographs by processing at the sites.

Some of the early pictures taken by TIROS I were flown by Army Signal Corps pilots from Fort Monmouth to NASA in Washington for release. This special air courier system was arranged to insure rapid delivery of the photos and to provide backup for electrical transmission means. It represented a timely and efficient merging of Army aircraft capability with the meteorological operation of the satellite. The Signal Corps also provided the facsimile photo transmission link between the tracking station at Fort Monmouth and NASA. Besides this alternate means of moving acquired weather photographs, full-time teletypewriter communications were supplied in the Army's world-wide network to various ground stations, NASA, the U.S. Weather Bureau station at Suitland, Maryland, and RCA facilities. These circuits were used for control and operation purposes.

The entire satellite system—including TIROS I and its instrumentation and the ground station equipment—was developed under the technical supervision of the U.S. Army Signal Research and Development Laboratory, Fort Monmouth, by the Astro-Electronic Products Division of RCA.

TIROS I is shaped like a round pillbox and weighs 270 pounds. It is 42 inches in diameter and 19 inches high. Because it is spin-stabilized in space like a gyroscope, its bottom surface only faces the earth during part of its orbit. The transmitting antennas which send signals to the ground stations and the television cameras are mounted on the bottom of the satellite. A receiving antenna projects from the top surface. The base of this antenna, which is used for reception of ground station signals, can be seen in Figure 4.

The spin control feature of TIROS I is a result of Army Signal Corps experience in developing its predecessor, VANGUARD II. This first weather satellite experiment was designed and built by the Laboratory and launched in February 1959. Its sensors operated in the near infra-red part of the spectrum. They could not provide the photographic data acquired by the more advanced and "second generation" TIROS I. VANGUARD II, wobbled and made interpretation of its information extremely difficult. This problem gave rise to developing a spin control technique in TIROS I to overcome this difficulty.

At the same time, VANGUARD II, although a more crude beginning in the use of weather satellites, was the technical forerunner of today's TIROS I. In the same way, TIROS I is the predecessor of ultimately the satellite with added infra-red instrumentation and the possible eventual network of orbiting U.S. weather satellites. VANGUARD II produced implications and feasibility answers of significant consequence in the construction of these later weather satellites, such as TIROS I and those which will succeed it.

Electrical power for TIROS I is supplied by solar cells arranged in banks. The satellite use of solar cells —or sun batteries—was also pioneered by the Army. They operate directly when the space vehicle is in the sun and also charge lightweight storage batteries for alternate power when it is in the earth's shadow. Aside from the infinite life and practicality of this means of providing satellite power, solar cells save weight by eliminating the need for conventional batteries. Together with small storage batteries for alternate power, which the Signal Corps has developed, solar cells permit this extra space and weight to be used for added satellite instrumentation or payload.

The feasibility of using solar cells for satellite power was demonstrated by the Army Signal Corps on VANGUARD I (Figure 5). The solar cell conversion used by this successful earlier satellite was developed by the Army's Signal Laboratory, employing commercially available solar cells. It is the first known use of solar power for satellites. The Laboratory also fabricated a more complex solar ring for the Army's EXPLORER VII, launched October, 1959. Several later U.S. satellites have used solar means of providing power for their electronic payloads. TIROS I is one of the latest of the American satellites to do so.

The Army Signal Corps is proud of its role in the national team which produced TIROS for the United States. Its military and civilian members can look back on other significant meteorological contributions since the days of 1870 when Signal telegraphers first undertook meteorology.

In military efforts, the Corps has provided small, mobile meteorological sets such as the trailer-mounted equipment for use with Army missiles. Signal scientists have conducted upper atmosphere weather exploration through the use of LOKI rockets and exploding chaff, or tin-foil fired to high altitudes and tracked by radar. A newly developed rocket-borne weather-sonde has increased the possible heights from which these weather devices can regularly send back data. The weather-sonde is hurled aloft in a small rocket instead of being carried by the familiar balloon.

Many weather system developments have equally important meaning to the national civilian community. Weather radars developed by the Signal Corps have led to comparable equipment now in civilian operation. Radar itself — with its manifold weather study uses and universal application in weather routing by our airlines—was originally developed by the Army Signal Corps when it provided the first American radar prior to World War II. A severe storm weather network was developed which is now in experimental use by the Air Force. The system includes a central station and its detection stations which pick up and relay indications of static generated in storm centers. The information is displayed on an electronic map in the central station, allowing operators to monitor threatening weather buildups and to locate and follow the movement of severe storm centers.

With VANGUARD II, and the more recent TIROS I, the Army Signal Corps has helped carry meteorology into space and perhaps to an even more infinite promise for the benefit of mankind.

Constructing open telegraph lines through unsettled and sometimes hostile country is more than the proverbial crow's flight to operating space electronics gear which can order weather satellite pictures three orbits in advance. It is the remarkable pace of American progress in meteorology. The members of the United States Army Signal Corps, in this, the hundredth year of Signal service, are privileged to have been a part of that progress.

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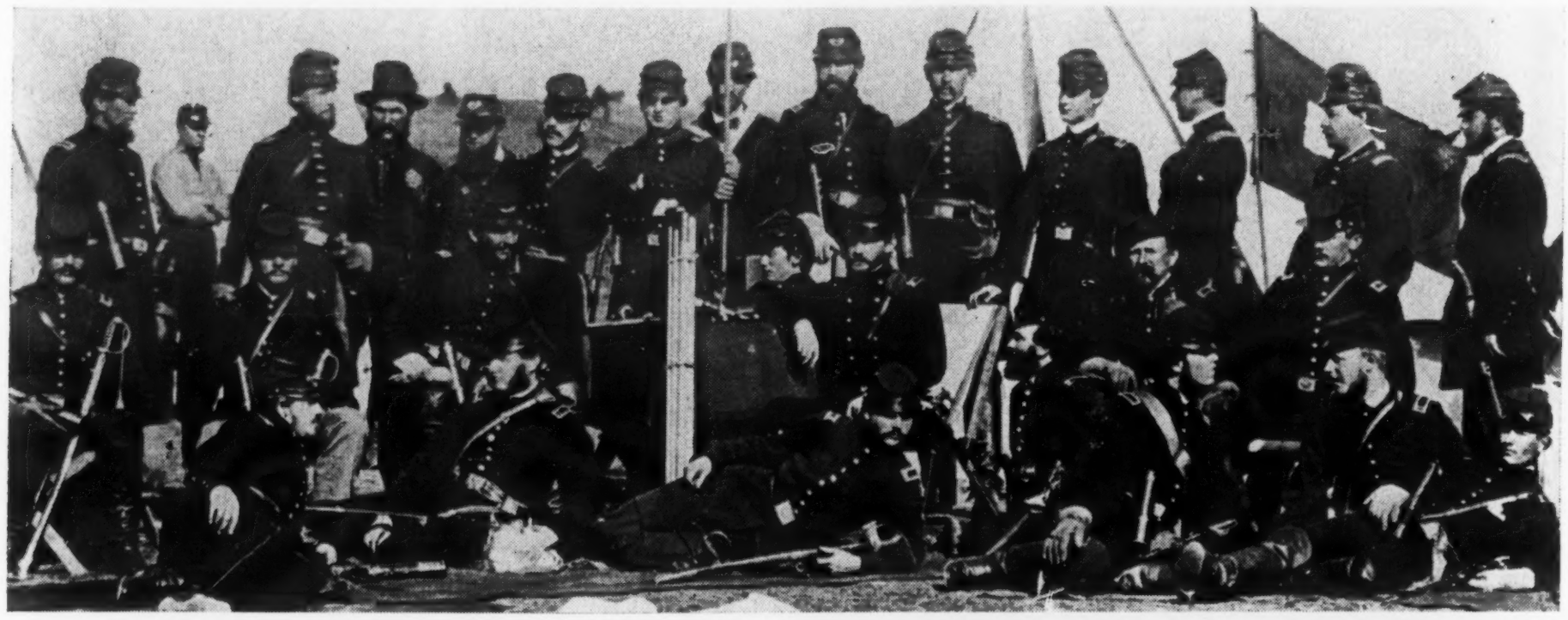
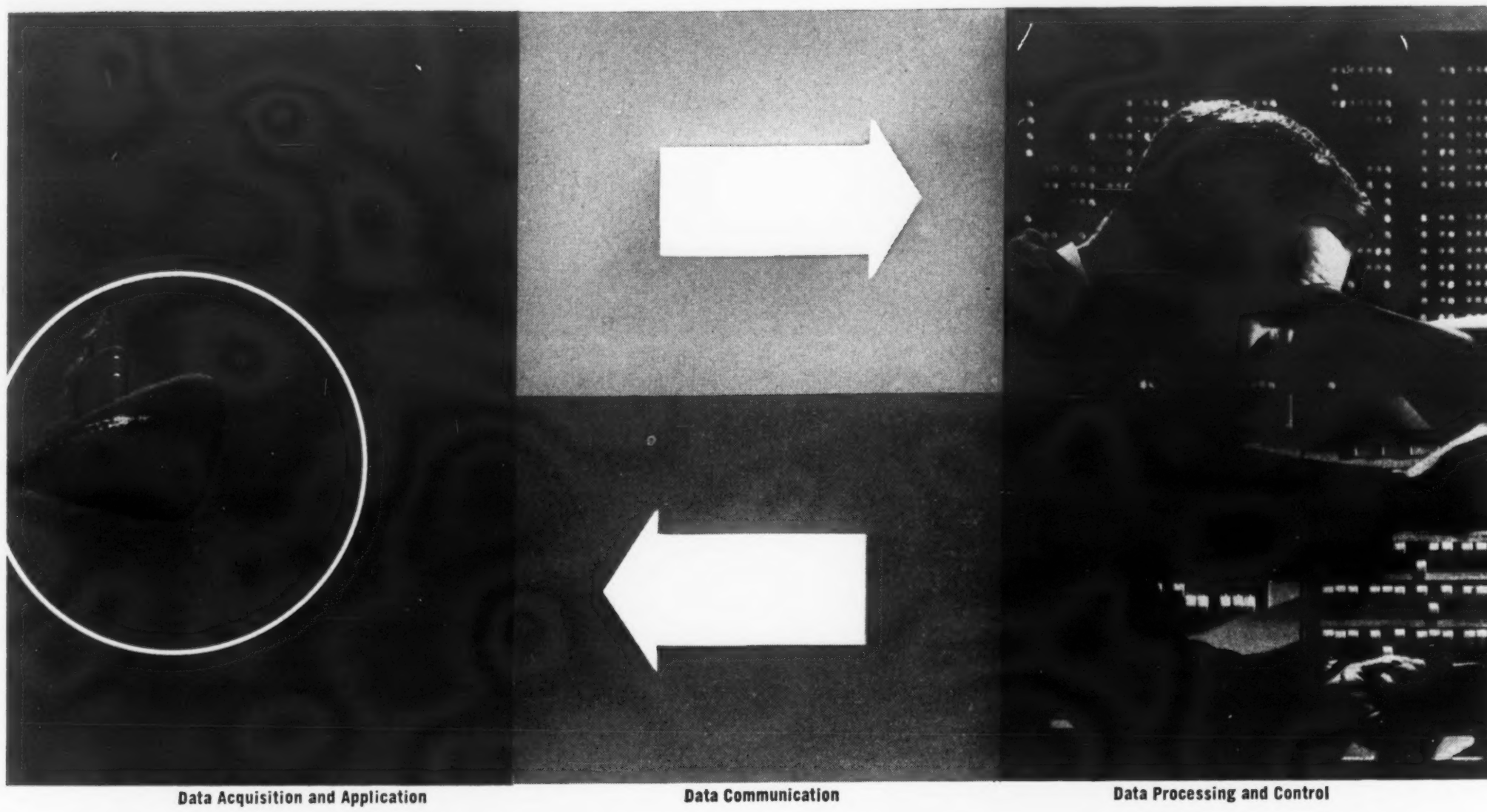
A PICTORIAL HISTORY OF THE SIGNAL CORPS



(top) ***Group of Signal Corps Officers at camp instructions.*** (top left) ***Manila, Fort Malate, Signaling for reserves to advance after retreat of the Spanish, 13 August 1896.*** (top right) ***Signal Corps Battery Wagons. Field Telegraph Train for four mules, 1898*** (bottom left) ***Manila, Cable work on the Malecon Drive. 1902.*** (middle right) ***The crossroads in the Argonne woods, near Montfaucon, Meuse, France, showing an important switchboard, placed there by the 112th Field Signal Battalion, during the advance through the woods. 2 October 1918.*** (bottom right) ***The Lucas lamp used here, has replaced the heliograph used in previous wars as means of visual signaling both day and night. Pretz en Argonne, Meuse, France. 22 October 1918.***

(top) ***Manila, P. I. During the siege of Corregidor, the Finance Office, US Army, shared lateral No. 12 of Melinta Tunnel with the Signal Corps. Enclosed behind the partition (near right) are the code machines and telegraph operators of the Signal Corps Message Center. Members of the Finance Office staff appear in the foreground. The last submarine to contact Corregidor on 3 May 1942, picked up this copy. 24 April 1942.*** (top left) ***European Theater of Operations, a soldier traces a broken field wire line for splicing. 25 December 1944.*** (top right) ***Korean Conflict. On a line pole, a member of the Signal Corps leans dangerously over a cliff to fasten a jumper as the group rehabilitates lines from Tanyang to Chachon, Korea.*** (middle left) ***Serving as reconnaissance eyes and ears is the Army Signal Corps 8-pound tactical television camera. It has built-in batteries, freeing the cameraman for the first time from the cumbersome apparatus which limited his movements afoot.*** (bottom right) ***Army's new compact, all weather radar "eye" (AN/PPS-4 Radar Set) which can spot a single enemy moving a half-mile away in darkness or fog.*** (bottom left) ***The defense action from the Defense Commander's tactical console is monitored at the Missile Master installation at Fort George G. Meade, Md.*** (Continued on page 29)



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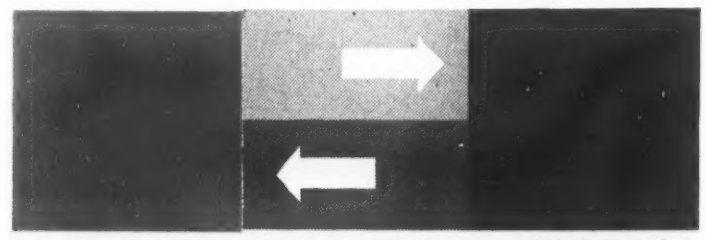

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LEFT: At the opening ceremony of the last automatic relay center in the AIRCOM System, at Siegelbach, Germany, Gen. Frederic H. Smith, Commander, U.S. Air Force in Europe, (second from right) receives teleprinter message from James H. Douglas, Deputy Secretary of Defense, which officially opens the center. Pictured with Gen. Smith are Ray Hoover, Vice President Plant, Western Union; Walter P. Marshall, President of Western Union; Maj. Gen. James Dreyfus, SigC, Director for Communications-Electronics, Joint Chiefs of Staff, and Maj. Gen. Harold W. Grant, Director, Communications-Electronics, USAF. RIGHT: Receive aisle is at the right and console position, left.

USAF DEDICATES AUTOMATIC GLOBAL COMMUNICATIONS

by Major General Daniel C. Doubleday, USAF
Commander, Airways and Air Communications Service (AACS)

THE COMMUNICATIONS complex of the United States Air Force is best described as the most modern and responsive of the world. The fibers of its networks reach the four corners of the globe, and the complex of radio and wire facilities interlace Air Force activities from the highest headquarters to the farthest tributary station. It provides communications for operation, command, weapon system support, management and administration for a global Air Force.

The Air Force communication complex consists of several distinct networks, each providing a specific type service. These networks all use their own allocated channels within the complex, yet are capable of being rapidly interchanged as priority of operations or volume dictates. These networks combined can handle well over one-half million messages daily.

One part of this complex is a world-wide integrated teletype relay network consisting of radio and land-line channels. It includes Air Force owned and operated teletype and radio facilities, leased Air Force operated commercial teletype equipment, and United States Army and Navy radio and wire circuits allocated to Air Force use. The traffic is handled on a "common-user" basis, that is, a common system used by all Air Force commands and units in contrast to private facilities used exclusively by a single customer. Although the net is configured primarily to serve the Air Force, traffic can and is freely exchanged with Army and Navy facilities as well as with the facilities of other nations through designated transfer stations. Over twenty million messages per year are delivered to addressees through this system.

The over-all common long-haul communications system was conceived in 1934 by General "Hap" Arnold, then a Lt. Colonel, when he led a flight of B-10's from Bolling Field, D. C. to Alaska and back. Special measures were implemented for this flight but the general lack of adequate communications for the control of such military air movements led Arnold to urge the development of an integrated communication system. Four years later a small system made up of thirty-three ground stations and manned by three hundred enlisted men and three officers was formed by Congressional authority. From this meager beginning the communication system grew to a world-wide flight facility and point-to-point system, operated by fifty thousand men during World War II. As a result of the rapid demand for communications equipment during this period, standardization of a system was impossible. At the end of the war, it was determined that the teletype network then in existence was neither efficient nor economical. The advent of the jet age brought with it an immediate need for a simple and rapid means of communication. This demand was first met by the adaptation of the Western Union Plan 51 semi-automatic system. Although this system was a great improvement over our previous conglomeration of networks, its limitations prevented it from being accepted as the long range answer to our traffic problems. Inherent limitations of this system were: its limited capability, its inability to treat high precedence traffic separately, its vulnerability to the human element, and its complete dependence upon peak load circuit engineering. These deficiencies became obvious soon after the initial implementation of the system. With the added traffic resulting from the Korean War and the rapid expansion of the Air Force, it was necessary to establish a second network for the Air Materiel Command and finally, a third system to meet our aircraft movement requirements. Taking all of the above requirements into consideration, operational characteristics were developed for a new system. These characteristics were placed into the hands of industry, and after a considerable amount of exploratory effort by several firms, the Western Union Telegraph Company was awarded a contract for the manufacture, and the lease of five automatic stations within the United States, and the purchase of five additional centers for installation at key overseas locations.

In a ceremony held May 9, 1960 at Siegelbach, Germany forty miles west of the Rhine, Major General Harold W. Grant, Director of Communications-Electronics, United

(*Continued on page* 28)

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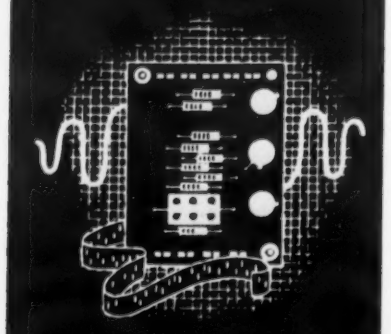

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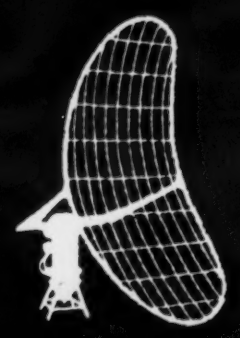

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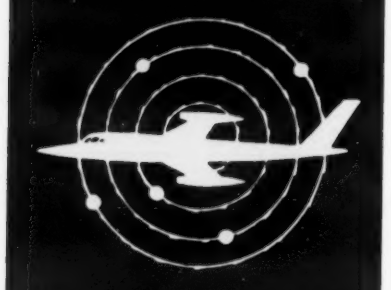

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In recent years, Sylvania has developed numerous types of broadband receivers, signal analyzers, and sensing devices across the entire spectrum. Advanced anti-intrusion devices are now under development. In addition, Sylvania is developing and managing several other highly classified programs in this area.

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Sylvania leadership in electronic warfare is typified by its advances in countermeasures and counter-countermeasures against all known types of electromagnetic radiation. Sylvania manages the passive defense system for the B-58, and maintains a quick-reaction capability and facility for Army ground-based electronic warfare activities.

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SYLVANIA ELECTRONIC SYSTEMS
Government Systems Management
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GENERAL SYSTEM

USAF Dedicates

(*Continued from page* 25)

States Air Force, officially accepted the Plan 55 Automatic Telegraph System on behalf of the Air Force, after an opening address by General Frederic H. Smith, Jr., Commander, U. S. Air Force in Europe. This communications system referred to as Plan 55 is a fully automatic telegraph relay system using five automatic major relay stations in the Continental United States and one each in Japan, Hawaii, England, Spain, and Germany.

Deputy Secretary of Defense James H. Douglas addressed the assembly of dignitaries at Siegelbach via telephone from the USAF Communications Center in the Pentagon. Mr. Douglas also depressed a golden telegraph key which automatically sent the first message to Siegelbach. Immediately following Mr. Douglas' message was a note of congratulations from General Thomas D. White to Brigadier General J. Francis Taylor, Commander, European-African-Middle East AACS Area.

These stations are interconnected within the Continental United States by a network of direct trunk channels, each capable of handling message traffic at a rate of 100 words per minute with direct connections to all relay stations. Messages originating within the Continental United States and addressed to other United States stations will flow through a maximum of two relay stations. Hence, a message originating in the Pentagon addressed to Vandenberg Air Force Base in California will enter the network at the Andrews Air Force Base, Maryland switching center, traverse the continent by high speed trunk to the McClellan switching center at Sacramento, California, where it will be switched automatically to the tributary station at Vandenberg. After manual preparation of a perforated tape in the Pentagon, no other manual operation is required until the message reaches its destination. To extend this network to overseas commands, and permit free (automatic) exchange of traffic between the Continental United States portion of the network and the various overseas portions, gateway stations have been established on the east and west coasts. These stations at Andrews and McClellan Air Force Bases actually serve two distinct purposes; first, as a relay station within their respective geographical areas, and second, as the point of exit and entry for traffic flowing from, or to overseas areas. Andrews serves as the gateway station for all traffic to North Atlantic, United Kingdom, European, Middle Eastern, North African, South Atlantic, and Caribbean Air Force activities, while McClellan serves all Pacific and Alaskan Air Force stations. Its area of responsibility extends as far as Japan and Australia. It now becomes apparent that a message originating in Fuchu, Japan, transmitted to any location in Europe still requires manual processing only at the point of origin. By use of the joint Army-Navy-Air Force routing instructions, routing indicators inserted in the lead end of the message tape are recognized by the automatic switching centers, causing the messages to be forwarded to their end destinations.

Each Plan 55 switching center is composed of a group of identical, self-contained incoming line, or receive consoles each equipped with two complete sets of receiving equipment; a group of outgoing line, or send consoles, each similarly equipped to accommodate two send lines; one or more director cabinets, depending upon the size of the switching center; a master control console; local teletype positions as required; and a bank of recorders designed to monitor all outgoing transmissions. These basic components are all interconnected by cables, and they contain the features required for automatic message processing. The system is designed to permit rapid increases or decreases in station capacity. Receive and send cabinets may be added, or deleted, as conditions dictate without system modification. The basic system, consisting of one receive and one send cabinet, together with associated common equipment, may be expanded to accommodate 200 send and receive channels merely by adding, via the "plug in" method, additional consoles. Further, expansion to 400 channel capability is possible with minor additions to each cabinet. A typical Air Force switching center as now installed, is equipped for 100 channels. The gateway stations are larger, of course. A message is received in one of the positions of a receive console, where a loop-gate transmitter distributor senses the receipt of a "Start of Message" function in the perforated tape created by the receiver perforator. The position is then temporarily and automatically connected to the director. The director reads the message precedence and routing instructions which appear after the "Start of Message" function, and establishes either a "Hi" or "Low" precedence cross office connection to the desired send console. If the message requires two or more onward transmissions, multiple cross office connections are established to permit simultaneous transmissions to at least four send positions. If one of the send positions is not immediately available, or if more than four forward transmissions are required, a spillover position is automatically selected. The spillover position functions exactly as a standard receive position, repeating the cross office selection process for the onward transmissions not processed the first time. Automatic routing line segregation is accomplished during each cross office transmission. Hence, only the routing indicator(s) required for onward handling of a given transmission appears at any given send position. An additional feature of the receive console, is the sequence number indicator. This device ascertains if the incoming message numbers are in sequence and alerts the cross office equipment that a message has been completely received. Messages received out of sequence, or an omission or duplication of a number will cause an alarm to sound and stop cross office action until an attendant has checked the position, determined the problem, and taken corrective action.

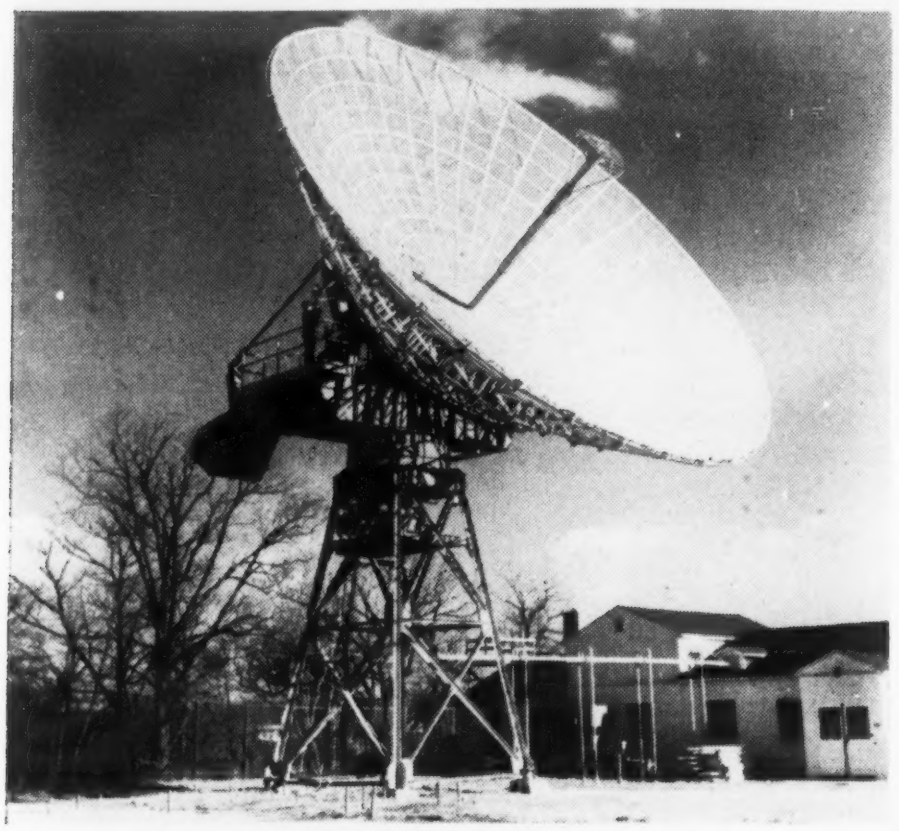
Director cabinets are included in sufficient number to provide at least 100% back-up in case of a director failure. Additionally, each receive console is equipped with a pushbutton panel, thereby making it possible to operate manually in the event of complete failure of all directors. As the message is transmitted cross office to the send console, it is preceded by the incoming channel number, and a new sequence number identified with the outgoing line. Also the "Start of Message" function is added. As this "Start of Message" function reaches the outgoing line console transmitter, a top line monitor recorder is connected into the circuit. The transmission to the line then begins, and the recorder disconnects after it has received essential routing information. This record serves for analysis purposes, station semi-permanent records, and possible tracer actions. An "End of Message" machine function, inserted at the end of each message by the originating station operator is sensed by the cross office transmitter. In so doing, it causes the cross office connection to disconnect and conditions the position to process the next messages.

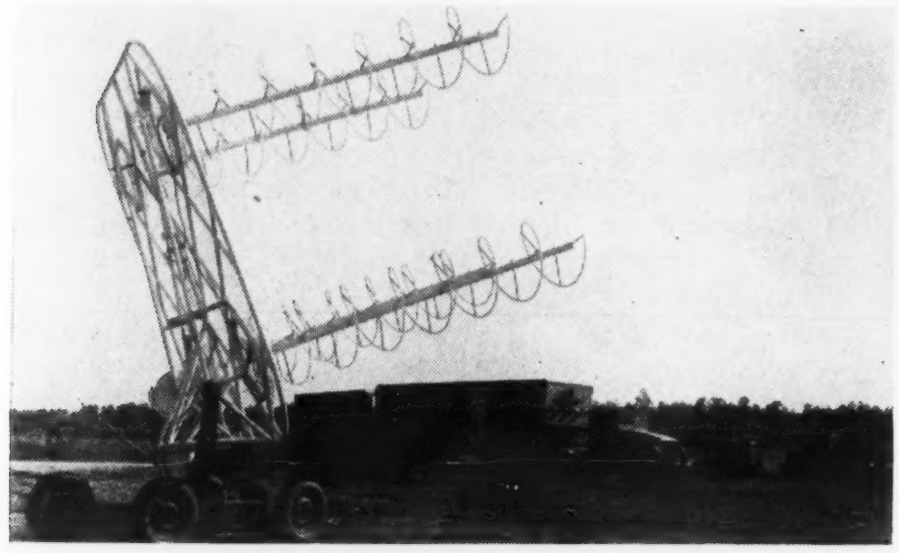
The control console is a central point from which all internal operations may be monitored. At this posi-

(*Continued on page* 41)

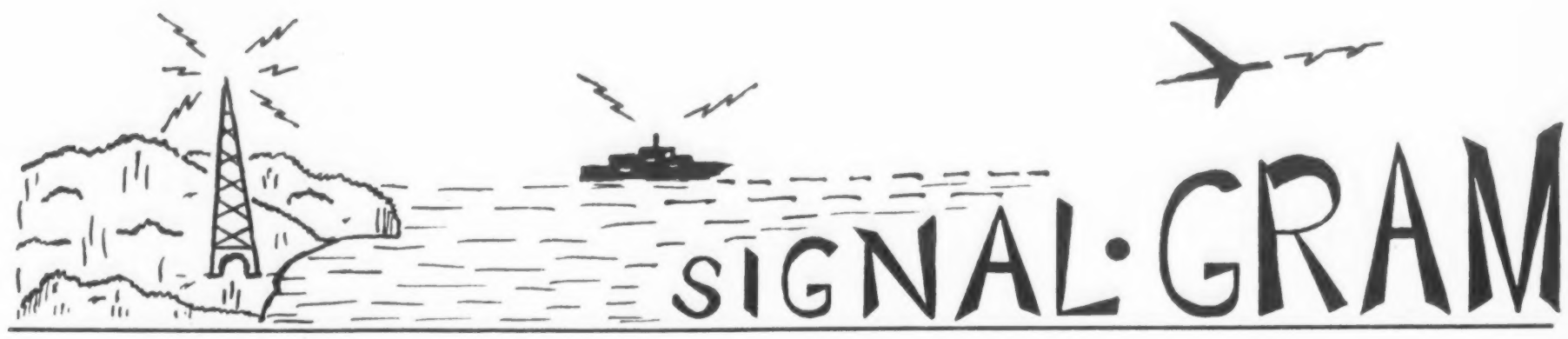
A PICTORIAL HISTORY OF THE SIGNAL CORPS

(Continued from page 23)





(top left) ***The sphere spotter, giant 50-foot antenna of the Signal Corps Engineering Laboratories' famous Diana moon radar at Fort Monmouth.*** (top right) ***Using the Army's new combat radio-telephone system mounted in a jeep, a soldier can ring a distant switch-board operator and be connected directly to another jeep miles away.*** (middle left) ***Messages were transmitted to and received from the Project Score Satellite, world's first communication Satellite, through use of the intricate antenna at the left and other electronic equipment located in the mobile vans of the US Army Signal Corps.*** (middle right) ***The photo of successful flight test of combat surveillance drone SD-2 shows rocket-aided high-speed take-off from launching vehicle at US Army test station at Yuma, Arizona.*** (bottom left) ***A soldier listens to a signal picked up by a new experimental "ruby maser," a device that is pound for pound the most sensitive detector in the history of science.*** (bottom right) ***High speed magnetic tape to magnetic tape communications machine.***



— GOVERNMENT —

SUNFLOWER I, a solar auxiliary power system for space craft, will be developed by the TAPCO Group of Thompson-Ramo-Wooldridge, according to the National Aeronautics and Space Administration. The solar system will be designed to generate 3,000 watts of electrical power continually for a one-year period and has potential uses in satellites and in lunar or planetary space craft. Costing about $4.9 million, the 700-pound system will consist of a large foldable solar collector, a boiler which uses solar energy to boil liquid mercury, a turbogenerator driven by the mercury vapor to produce electrical power and a condensor-radiator to dissipate heat.

AGENA-B LAUNCH VEHICLES will be used as the second stage on some future National Aeronautics and Space Administration projects as the result of an agreement between NASA and Lockheed Aircraft Corp. whereby the space agency will buy 16 Agenas from Lockheed, the firm that assembled the vehicle, at a cost of about $50 million. Deliveries of the 25-foot vehicle will be spread over the next three years. Containing an engine capable of developing 15,000 pounds thrust, the Agena-B will be used as the second stage atop both Thor and Atlas boosters on space projects scheduled to begin in 1961. Spacecraft flown on Atlas-Agena-B will be used mainly for lunar investigations. Thor-Agena-B will boost a number of earth satellites, including Nimbus, the meteorological satellite slated to succeed the present Tiros series.

TENTH ANNIVERSARY OF NATIONAL SCIENCE FOUNDATION was celebrated May 12 at a dinner during which Dr.George B. Kistiakowsky, science advisor to the President, gave a major address. May 13 marked the tenth anniversary of the signing of the National Science Foundation Act by President Truman. During its first year NSF made 96 basic grants totaling over $1 million. During 1959, the most recent year for which total figures are available, NSF made 1,809 basic research grants totaling over $49 million.

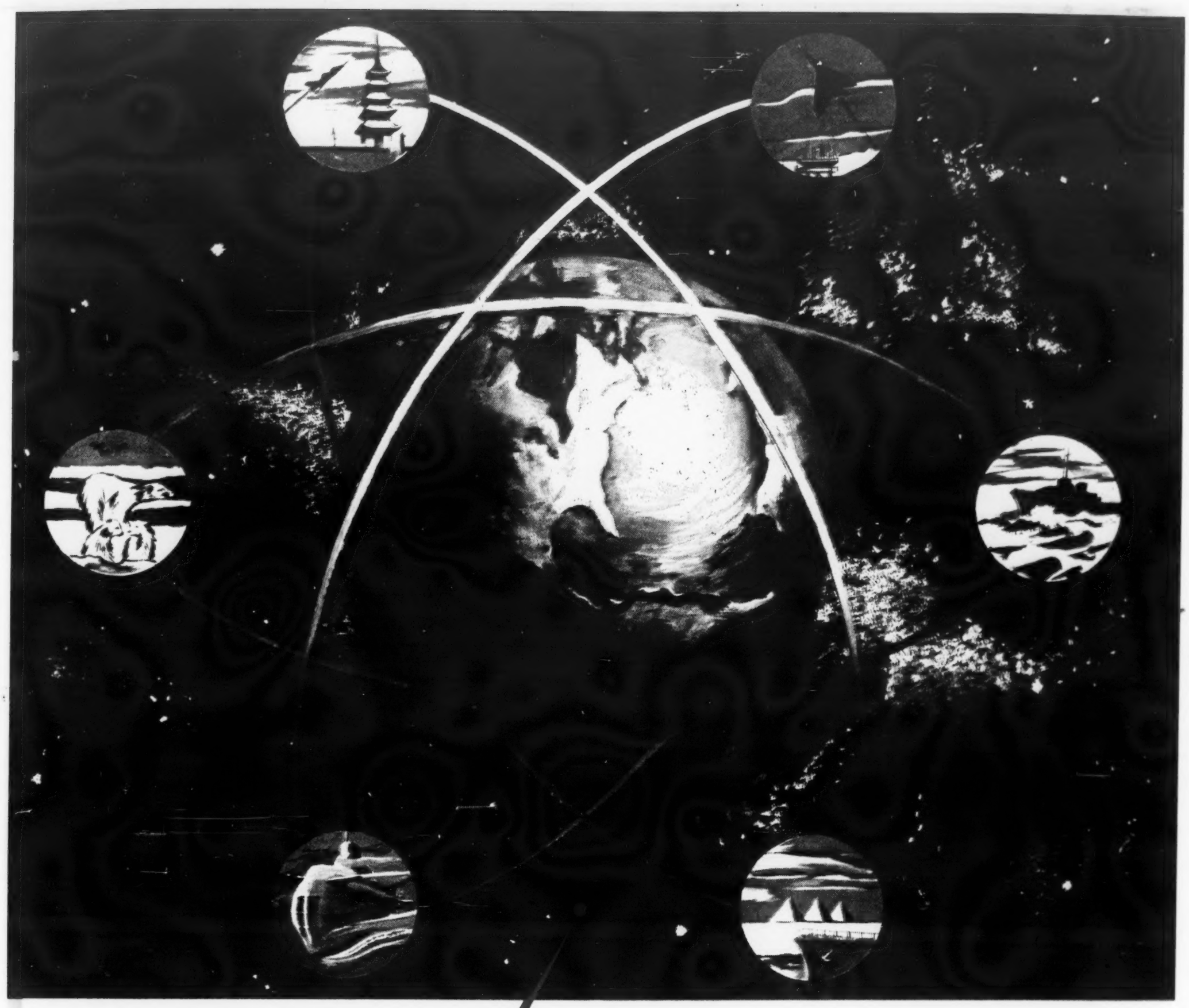
AIR FORCE BOMARC-B MISSILE made its first completely successful launching April 13 at the Eglin Air Force Base, Florida, according to the Air Force. The 47-foot interceptor missile reached a cruising altitude of about 12 miles and streaked more than 170 miles down range from the launching site before descending into the Gulf of Mexico. The solid propellant booster rocket was not fired at a target.

U. S. MILITARY CEMETERIES AND MEMORIALS of World War II will be dedicated in six countries next month. The American Battle Monuments Commission is planning the dedications which will be held in Luxembourg City, Luxembourg; Margraten, Holland; Liege, Belgium; Neuville-en-Condroz, Belgium; Brest, France; St. Avold, France; Carthage, Tunisia; Florence, Italy. The Department of Defense and the Armed Forces will participate in services at each of the dedications.

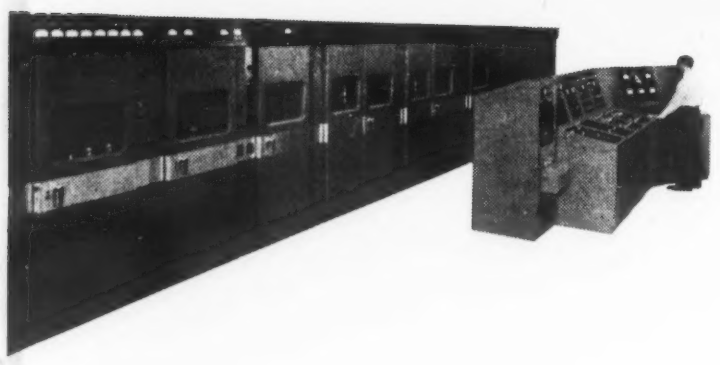
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION has selected two companies to do engineering and preliminary development studies on an electric rocket engine. Such engines show promise of one day powering space craft on interplanetary missions by supplying a small but steady amount of thrust over a period of months, NASA believes. From among eight companies submitting proposals for a 30-kilowatt plasmajet engine, Avco Corp. and General Electric Co. were selected for contract negotiations.

AIR TRAFFIC CONTROL COMPUTER now being tested by the Federal Aviation Agency is the key element of a new data processing system that will improve coordination from takeoff to touchdown of civil and military flights within a single FAA control complex. Undergoing tests at the FAA's experimental center at Atlantic City, N. J., the computer was designed and manufactured by Librascope Div., General Precision, Inc. As programmed for the New York area, the computer will be able to process and print up to 1,600 flight progress strips per hour, process 440 flight plans per hour and store a total of 1,000 flight plans.

(Continued on page 31)



In One Instant...



Two million watts will blast the U. S. Navy's radio signal anywhere in the world . . . even to a submerged submarine on the other side of the earth!

This new 2,000,000 watt VLF transmitter being built by Continental Electronics will be the most powerful in the world. With this transmitter the Navy can communicate dependably with any spot on earth. It is being built by the specialists in b-i-g power transmitting equipment.* Again, the Navy knows it is getting the very best available — another Continental Electronics transmitter.

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A SUBSIDIARY OF LING-ALTEC ELECTRONICS, INC.

WORLD WIDE communication WITH EARTH satellites

by DR. HENRI BUSIGNIES AND LOUIS POLLACK ■

ALTHOUGH EXPLODING populations have figured prominently in the world's press over the past two years, a similar but unheralded explosion has been taking place in the communications industry, and with equally far-reaching effects. Transoceanic traffic, growing at a rate that outstrips available circuit capacity, has spurred some remarkable advances in the science of communications.

Tropospheric and ionospheric scatter techniques have increased inter-terminal transmission spans from the line-of-sight distance of 20 to 40 miles to as much as 600 miles in the case of tropospheric scatter and 1200 miles for ionospheric scatter. But linking transoceanic terminals demands new and more dramatic developments. The space platform, or earth satellite is the development which will enable the communication engineer to link the world.

Need for Earth Satellites

More than 66 million[1] commercial telephones are interconnected in the United States. Any one of these can be linked—through approximately 200 overseas circuits—with the 65,000,000 telephones distributed throughout the remainder of the world. In addition, the nation's world wide military bases require long haul inter-connection to strategic and administrative headquarters.

The daily capacity of overseas circuits is estimated as 40 messages per channel or an annual capacity of 14,400 messages for each channel. Present circuit capacity is limited to about 3 million messages annually. Traffic anticipated next year will exceed present capacity. Further expansion of HF radio circuits is unlikely because of spectrum crowding and the relatively undependable service. Submarine cables with wide band repeaters are being developed to a high degree of perfection; transoceanic cables planned for the 1968-70 era will be capable of 60-100 channel capacity. Even this limited increase in overseas message capacity will not meet predicted traffic growth.

A means of transmission is needed that will immediately provide several hundred channels linking key cities throughout the world. This requirement will be filled by a satellite communication system.

Let us consider the communication problems in establishing a satellite repeater.

(1) *Choice of Operating Frequency*

The selection of an optimum frequency for the satellite system, whether passive or active, is limited to the propagation "window" between 100 Mc and 10 Mc.

Atmospheric and man-made noise decreasing inversely with frequency[2] becomes negligible above 100 Mc. Cosmic noise decreases from a level of —160 DBW/Kc at 100 Mc to less than —180 DBW/Kc at 1000 Mc. Other effects, such as Faraday rotation of the plane of polarization and those produced by nuclear explosions, become progressively less as frequency increases becoming negligible above 2 Kmc.

At the upper bound, oxygen and water vapor absorption increases with frequency[3] from 0.01 DB/Km at 10 Kmc to greater than 0.1 DB/Km at 20 Kmc.

Propagation loss, in the passive case, is given by:

$$L = Pt/Pr = 16 \quad \frac{\lambda^2 d_1^4}{A^2 n^2 D^2}$$

Pt = Transmitting Power
Pr = Receiver Power
λ = Wavelength
d_1 = Geometric Mean of Distance between Satellite and Terminal
A = Antenna Area
n = Antenna Efficiency
D = Satellite Diameter

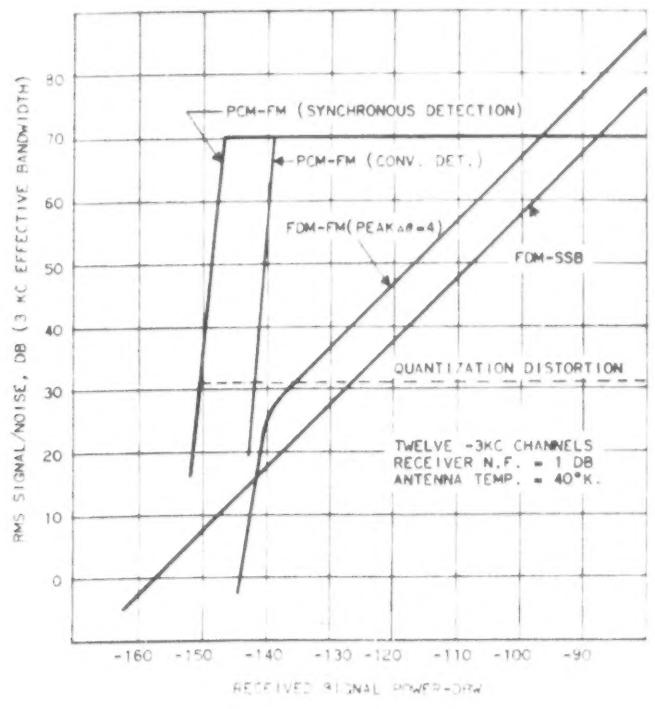

fig. 1 (left)—comparison of modulation systems

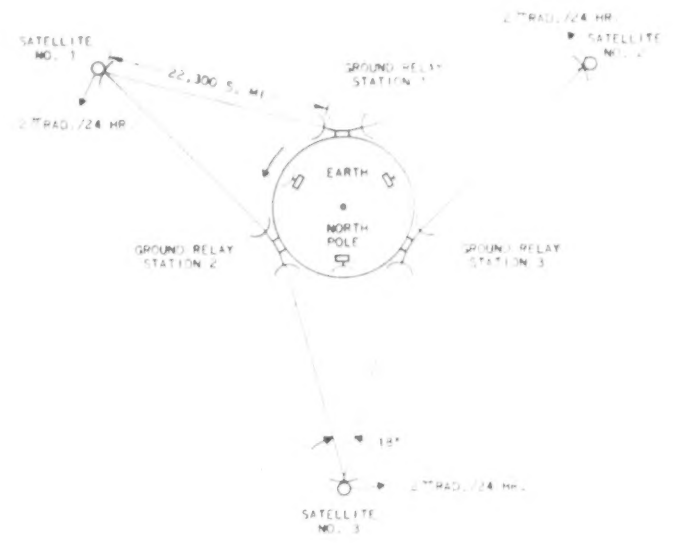

fig. 2 (above)—24-hour satellite system geometry

■ ***Dr. Busignies is Vice President and General Technical Director of International Telephone and Telegraph Corporation and Mr. Pollack is Executive Engineer, Transmission Laboratory, ITT.***

Note, the transmitted power is a function of the fourth power of distance, and loss decreases with increasing frequency for fixed ground antenna and satellite antenna size.

In the active case, the satellite antenna gain will be limited by the area of the earth to be covered and the error tolerance of the attitude stabilization system.

The satellite antenna beamwidth will be fixed for a given orbit. For this case of constant beamwidth at the satellite and fixed antenna size on the ground, the path loss is independent of frequency and is given by:

$$L = Pt/Pr = K \frac{d_2^2 \theta}{nA}$$

d_2 = Distance Ground to Satellite
θ = Satellite Antenna Beamwidth
A = Ground Antenna Area
n = Ground Antenna Efficiency
K = Constant

The quantity of information that can be transmitted over a communication system is proportional to bandwidth. Practical equipment design considerations limit bandwidths to the range of 0.5 to 2% of carrier frequency. For communication systems which use a modulation scheme yielding a large noise improvement factor, bandwidths will range from 10 to 40 Mc. This equipment design constraint is satisfied at 2 to 4 Kmc.

Two further factors may be considered in determining the optimum frequency:

(a) Satellite components, particularly RF amplifiers and antennas decrease in size and weight with increasing frequency.

(b) The efficiency (DC power input vs. RF output) of transmitters varies with available distribution. Thus, at lower frequencies substantially higher efficiencies are available.

This question of efficiency is by far the more important because cost and weight of power supplies and the problem of dissipating heat are two important factors for a satellite relay. Even a 20% variation in required transmitter input power in general will be much more important than a doubling or halving of the antenna or RF amplifier weight. The selection of an operating frequency then becomes a matter of determining which of the frequencies between 2,000 and 10,000 Mc can be generated and transmitted most efficiently based on equipment availability and state of the component art.

(2) *Choice of Modulation System*

The optimum type of modulation is defined as that which yields the greatest power efficiency for a given signal-to-noise ratio. Since satellite power is limited, the modulation scheme that will yield the desired channel signal-to-noise, say 40 to 50 db, with the least transmitted power is the preferred method. Therefore, a type of modulation is desirable which allows substantial improvement of the channel signal-to-noise ratio over the carrier-to-noise ratio at the expense of bandwidth.

Since demodulation need not occur in the satellite, the type of modulation can be changed at the ground station if the translator or reflector is sufficiently broadband. Three principal types of modulation have been considered:

(1) Frequency-Division multiplex with amplitude-modulated sub-carriers which apply single-sideband modulation to the RF carrier (FDM-SSB).

(2) Frequency-Division multiplex with amplitude-modulated sub-carriers which frequency modulate the RF carrier (FDM-FM).

(3) Time-Division multiplex with pulse-code modulation, with the pulses frequency modulating the carrier. Several groups of carriers can be multiplexed in frequency to obtain the total number of communicating channels (PCM-FM-FDM).

The signal-to-noise for each system is given by:

FDM-SSB

$$S/N = C/N = 10 \log \frac{1}{(KT)} - 10 \log b - L + 10 \log Pt$$

K = Boltzman's Constant 1.38×10^{-23}
T = Effective Temperature of the Receiver
b = Signal Bandwidth
L = Path Loss in db i.e., The sum of Receiving and Transmitter Antenna gain and free space loss.
Pt = Transmitter Power

FDM-FM

$$S/N = C/N + 20 \log \frac{\Delta f}{f} + 10 \log \frac{B}{2b}$$

when C/N is 12 db or greater.

$$C/N = 10 \log \frac{1}{(KT)} - 10 \log B - L + 10 \log Pt$$

f = Peak Deviation
f = Highest Modulating Frequency
B = IF Bandwidth

The RMS carrier to RMS noise ratio of 12 db is the accepted threshold of a Frequency-Modulated System. Below this value, the noise improvement is not realized.

PCM-FM

For the PCM-FM case, we must first decide what is the bandwidth of the system.

By using a 6 bit code and sampling at twice the highest audio frequency, the bit rate for each voice channel is 6×8000 or 48,000 bits/second and the sampling frequency is $\frac{48{,}000}{2}$ or 24,000 cps.

To transmit the video information of a multi-channel system with the least power, a gaussion shaped bandpass response is used. It has been shown that the 3 db bandwidth of the over-all system should equal 2 times the video rate to obtain an acceptable interchannel cross talk ratio. Therefore, we will use an RF bandwidth equal to twice the sampling frequency.

Since the pulse information frequency modulates the RF carrier, we must exceed the FM threshold noted above. In addition, there is a PCM threshold below which the noise improvement fails. This point is reached when the pulse signal voltage cannot be separated from noise with great certainty. An RMS video signal to RMS noise of 9 db is an acceptable threshold value. Note, the PCM threshold is lower than the FM threshold. When the PCM threshold of 9 db is exceeded, the channel signal-to-noise is much greater than 40 db.

The carrier power required for the PCM-FM case, neglecting for the moment FM threshold, is:

$$P_{tr} = -10g \frac{1}{KT} + 10 \log B - 20 \log \frac{\sqrt{3}\,\Delta f}{f} + 9 + L$$

A class of demodulation referred to as synchronous demodulation will lower the usual FM threshold 3 to 6 db and the PCM threshold will determine the system breaking point.

(*Continued on page* 75)

Signalgram (*Continued from page 30*)

CONTRACTS: ARMY: Pan-American Airways, Inc., installation and operation of a facility for surveillance drone and electronic environmental testing at the Army Electronic Proving Ground, $18.8 million; Martin Co., construction of a new fire coordination system for Nike batteries, $3 million. NAVY: Bendix Corp., continued development and evaluation of the Eagle missile system, $21 million; Sperry Gyroscope Co., design and manufacture of navigational systems and installation of equipment for Polaris submarine fleet, $19.6; Collins Radio Co., development of electronic systems for Navy fighter aircraft, $1.5 million; AIR FORCE: The Hallicrafters Co., production of electronic countermeasure equipment designed to disrupt hostile radar and missile guidance systems for use on the Strategic Air Command's B-52 bomber, $12 million; Westinghouse Electric Corp., production of tactical scatter communications equipment for use in a tropospheric scatter communications system, $2.6 million.

— INDUSTRY —

LEVINTHAL ELECTRONIC PRODUCTS, INC., a subsidiary of Radiation Inc., will design and produce four tropospheric scatter radio power amplifiers for radio sets to be installed in England and Spain on a radio communications link over 500 miles. Levinthal received an $800,000 contract from Page Communications Engineers for the amplifiers which will be used in the communications complex Page is building under a contract to the Air Force.

SEMINAR ON FIXTURE DESIGN FOR VIBRATION TEST EQUIPMENT will be sponsored by MB Electronics, a division of Textron Electronics, Inc., and will be given at the Polytechnic Institute of Brooklyn. The five-day course will be offered in two sessions—June 20-24 and June 27-July 1. The fixture design seminar is the fourth in a general series on complex vibration testing initiated in June 1959 by MB.

WESTINGHOUSE ELECTRIC CORP. designed and built a thermoelectric refrigerator which was used in an Air Force life-sustaining space test. The one-cubic-foot unit was one of the key components of a manned capsule that housed an Air Force scientist on a simulated week-long mission into space. Designed to operate in the weightless environment of orbital flight, the Westinghouse unit is a complete food storage system. Thermoelectric refrigeration is achieved by passing an electric current through the proper kinds of semiconductor materials, Westinghouse states. The simulated space test was conducted at the Air Research and Development Command's Wright Air Development Division, Aerospace Medical Laboratory, Dayton, Ohio.

UNITED STATES UNDERSEAS CABLE CORP., a new company jointly organized by four firms, will provide for the design and construction of long distance underwater cable systems. Phelps Dodge Corp., Northrop Corp., Page Communications Engineers, Inc. and Felten and Guilleaume of West Germany organized the new company. United States Underseas Cable will offer a complete cable package, including users survey, route survey, engineering, installation and maintenance. Principal offices will be in New York City and Washington, D.C.

RADIATION INC. will develop and test airborne pulse code modulation (PCM) telemetry systems for the Air Force Titan intercontinental ballistic missile. The PCM airborne packages will be used in conjunction with Radiation's ground-based telemetry receiving stations. Use of pulse modulation in the Titan marks the first time a liquid propellant missile has employed this system of telemetry, acording to Radiation. Radiation will do the work under a $2,322,000 contract from AC Spark Plug, which has prime guidance responsibility for the Titan.

BENDIX CORP. has developed a distance measuring equipment device for light aircraft. The new unit is used as an accessory to conventional air-to-ground two-way radio to determine distance between an interrogator and responder. The same unit acts as an interrogator or responder, or the functions can be separated to reduce size and weight. Bendix officials recently demonstrated the 5-pound unit, designated NVA-203A, for officials of the Federal Aviation Agency and the Signal Corps Research and Development Laboratory.

LEASING PROGRAM FOR AIRBORNE WEATHER RADAR has been announced by Radio Corporation of America. The lease agreement will make weather radar units available to airline and business aircraft operators on a five-year basis with an additional option period of two years at reduced rates. The initial phase of the leasing program covers the RCA AVQ-10 and AVQ-50 airborne weather radar units as well as the AVQ-60B air traffic control transponder, which permits aircraft to advise air traffic control centers automatically of their location and identity. Other electronic aviation equipment will be added to the lease plan list later. (*Continued on page 36*)

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DIVISION OF
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INTERNATIONAL TELEPHONE AND TELEGRAPH CORP. has been awarded a $2 million contract by the U. S. Army Signal Supply Agency to build what is believed to be one of the world's longest microwave communication spans in the Pacific area. Designed to bridge an ocean expanse of some 500 miles, the link will employ ITT-developed over-the-horizon radio equipment using the tropospheric scatter technique. Specifications call for several voice channels as well as a teleprinter circuit.

FAIRCHILD CAMERA AND INSTRUMENT CORP. will construct an Environmental Test Laboratory, believed to be the first of its kind in the country geared to the testing of complete intelligence gathering and other systems under space environments. Under construction by the company's Defense Div. at Long Island, N. Y., the laboratory will contain a large altitude chamber capable of testing entire systems at altitudes up to one million feet.

— GENERAL —

U. S. COLLEGES AND UNIVERSITIES increased their scientific research and development expenditures 80 percent between 1954 and 1958, a National Science Foundation study shows. Expenditures increased from $409.7 million to $735.8 million during the four-year period. The study shows that in 1958 more than half the total expenditure was spent by agricultural experiment stations and Federal contract research centers administered by educational institutions, while the colleges and universities proper accounted for the remaining funds. The latter were more oriented toward basic rather than applied research, expending 74 percent of their funds for this purpose. Experiment stations and contract centers reported 35 percent and 24 percent, respectively, for basic research.

REMOTELY CONTROLLED COMPUTER capable of 50 thousand computations a second will be installed in Carnegie Institute of Technology's Computation Center next fall. Since the computer can be remotely controlled from different buildings on the campus, the various research centers can supply data to the computer and evaluate results from operating positions cutside the computation center. Known as the G-20 high-speed data processing system, the system was developed by Bendix Corp. It includes magnetic tape units that read and write at a rate of 120,000 digits per second.

MIDWEST PROGRAM ON AIRBORNE TELEVISION INSTRUCTION will sponsor workshops this summer for teachers and school administrators interested in the program. MPATI, as it is called, plans to beam instructional telecasts from an aircraft to 18 colleges and universities in six midwestern states starting in February 1961. The $7 million project is supported by the Ford Foundation and contributions of private industry.

U. S. SCIENCE FILMS are being received enthusiastically by Egyptians in Cairo, according to The New York Times. The science films are being shown as part of the Festival of American Scientific and Popular Films. Some of the films are the U. S. National Academy film "Research by Rockets", the Department of Defense film "Celestial Mechanics and the Lunar Probe" and the Atomic Energy Commission film "High Energy Particle Accelerators." The program is directed by the U. S. Information Service offices in Cairo with the cooperation of Cairo University and the Ministry of Culture and National Guidance. Because of "the warm response to the showings" plans may be made to send the films to other Egyptian cities, said the Times.

ELECTRONIC FLASH UNIT for use in detailed close-up photography on an around-the-lens installation has been developed by Hershey Manufacturing Co. Called the "Sun-Lite Sunring," the 1-pound unit will aid doctors, dentists and others in obtaining shadowless close-up shots in both black and white and color.

CALENDAR OF EVENTS

JUNE 10-26: British Exhibition of industry, technology, science and culture, sponsored by the Federation of British Industries, Coliseum, New York City.
JUNE 22-24: Standards and Electronic Measurements Conference, co-sponsored by the Professional Group on Instrumentation of the Institute of Radio Engineers, the Radio Standards Laboratory of the National Bureau of Standards and the Instrumentation Division of the American Institute of Electrical Engineers, Boulder, Colorado.
JUNE 27-29: Fourth National Convention on Military Electronics, sponsored by the Professional Group on Military Electronics of the Institute of Radio Engineers, Sheraton-Park Hotel, Washington, D. C.

A highlight of Signal Corps history: President Wilson talks to an airplane from the White House lawn in 1918 during a successful demonstration of aviation radio. A year earlier, to meet war needs, Western Electric had designed the first radio telephone for U.S. Army aircraft.

Western Electric salutes the Signal Corps on its 100th Anniversary of service to America

Western Electric is proud to have been working with the Signal Corps ever since the first telegraph lines were strung across the country late in the 19th century. In helping to meet the demands for communications and other electronic equipment, Western has provided the Signal Corps with telephones, switchboards, cable, radio telephone, vacuum tubes, transistors, radar, carrier telephony, and teletypewriters – to name a few. And just last December, final delivery was made on the new Spiral-4 Cable System—major parts of which were designed, developed and manufactured by Western Electric.

We at Western Electric extend our heartiest congratulations to the U. S. Signal Corps for a brilliant first century of progress. We're happy to have played our part – and look forward to a continuing relationship between the U.S. Signal Corps and Western Electric as we enter the challenging Space Age.

Western Electric

MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

NAVAL COMMUNICATIONS STATIONS/FACILITIES

★ ★ ★ ★

AND HOW THEY SERVE THE FLEET

THE NAVY of today is a complex, powerful and far-reaching force which spends more time at sea than did any of its predecessors. Naval units up to Fleet size operate under, over, and throughout the ocean areas of the world with great emphasis on speed, mobility and dispersal. A vital tool of command in the coordination of these forces is Naval Communications, the instrument by which the rapid communication effort of the Naval Establishment afloat and ashore is realized. The basic organization of Naval Communications is:

a. Assistant Chief of Naval Operations (Communications)/Director, Naval Communications
b. The Naval Communication System
c. Communication Departments of Shore Establishment Activities
d. Communication Organization of the Operating Forces

As Assistant Chief of Naval Operations (Communications), the Director, Naval Communications has general cognizance of the naval communication effort. Specifically under his management control is the Naval Communication System, a world-wide system through which all other elements of Naval Communications are linked.

In order to more effectively fulfill the mission of Naval Communications, the Naval Communication System Headquarters Activity was established in July 1959 to operate and manage the Naval Communication Systems, which is an integrated network forming the world-wide framework of Naval Communications.

The System is composed of Naval Communications Stations, Naval Communications Facilities and Naval Communication Units. There is essentially no difference between a Station and a Facility except that the latter is located on foreign soil. Each activity normally includes a communication center, a transmitter site, a receiver site, and all facilities and ancillary equipment required to provide a specific area with the essential Fleet and fixed communication services necessary to serve command and facilitate administration. The Communication Unit is a smaller activity, organized to fulfill limited functions and is under an Officer-in-Charge rather than a Commanding Officer. These activities are organized as self-contained units and are as self-supporting as required by their environment. The need to support Fleet requirements on a global scale dictates that they be located all over the world. The major activities of the Naval Communication System are:

U. S. Naval Communication Station Adak—Adak, Alaska
U. S. Naval Communication Station, Balboa—Fort Amador, C. Z.
U. S. Naval Communication Station, Guam—Guam, Mariana Is.
U. S. Naval Communication Station Kodiak—Kodiak, Alaska
U. S. Naval Communication Station Newport—Newport, R. I.
U. S. Naval Communication Station Norfolk—Norfolk, Va.
U. S. Naval Communication Station Pearl Harbor—Pearl Harbor, Hawaii
U. S. Naval Communication Station San Diego—San Diego, Calif.
U. S. Naval Communication Station San Juan—San Juan, P. R.
U. S. Naval Communication Station Washington—Wash., D. C.
U. S. Naval Communication Facility Japan—Yokosuka, Japan
U. S. Naval Communication Facility Port Lyautey—Kenitra, Morocco
U. S. Naval Communication Facility Philippines—San Miguel, Luzon, Philippines Republic
U. S. Naval Communication Unit Asmara—Asmara, Eritrea
U. S. Naval Communication Unit Seattle—Seattle, Washington
U. S. Naval Communication Unit Trenton—Trenton, N. J.

Additionally, the Naval Communications System includes Naval Radio Stations (Transmitter) (VLF) at Jim Creek, Washington and Cutler, Maine.

U. S. Naval forces operate in all the major ocean areas of the world, in some of them on a continuing basis, and in others as the need may require. The major communications

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activities listed above are located and designed to provide essential communications for the Fleet in these areas, including both Fleet broadcast and ship-to-shore.

These facilities are for the most part linked together by conventional high frequency radio, multi-channel, point-to-point circuits, normally 16 channel single sideband. In several locations linkage is by landlines or cable. Network stations, in addition to providing Fleet communications, also provide the communication services for the local commands within their geographical area. An average major communication station will operate 8 multi-channel point-to-point circuits plus the associated or ancillary short distance relay circuits and single channel radio teletype circuits. Using automatic switching and/or torn-tape relay, each installation also serves as a major relay point to pass traffic to other stations.

Broadcast service is the primary method employed for the transmission of message traffic to units of the Fleet and to merchant ships. Radio telegraph, radio teletype, and facsimile broadcasts are employed. Since ships are not required to receipt for messages received via the broadcasts, this method of delivery permits them to maintain radio silence. A major communication station will operate an average of 5 principal broadcasts. In order to cover the large assigned areas 24 hours a day, broadcasts are operated as simultaneous transmissions on a family of frequencies, usually 5, on a continuous basis. The types of service include operational, logistics and administrative, hydrographic, press, weather, radio photo (facsimile), merchant ship, and time signals.

Ship-to-shore services enable ships and commanders afloat to move message traffic into the Naval Communications System for relay to shore commands or to be retransmitted to other afloat units via the broadcast method. The shore stations maintain a guard on their assigned ship-to-shore frequencies; units afloat come up on the circuit only when they have traffic to deliver. Principal afloat commanders usually maintain continuous guard on ship-to-shore circuits, but the shore stations normally do not use this method to communicate to Fleet units except to transmit high precedence operational traffic.

In addition to the large volume of operational and administrative traffic handled by the Naval Communications System, other traffic of a special nature is transmitted for limited users. Of particular importance to commanders afloat is the point-to-point facsimile circuitry which is maintained to provide a means of passing weather charts and other graphic information to the shore stations for retransmission via the broadcasts to ships at sea which have facsimile equipment.

The local communication services available at the major stations afford send-and-receive communication service to other military and government activities in the area via complex landline and microwave systems. The Naval Communication Station Pearl Harbor, for example, serves 44 shore based activities in the area of Hawaii, including the staffs of principal commanders based ashore, material and supply activities, naval air stations, and other activities all engaged in Fleet operations or in support thereof.

An auxiliary function of the communications stations, but an indispensable one, is to provide space, facilities, and assistance for the test and evaluation of new equipment and for research and development projects. With the advent of the space age, this function has attained greater significance.

Many noteworthy advances have been made in Naval Communications during the past few years. Though not yet a part of the Naval Communications System, the Communications Moon Relay system recently was used to pass traffic between Washington and Pearl Harbor. This system shows promise of becoming a valuable asset to Naval Communications because of its ability to provide rapid, reliable communications when other systems temporarily fail due to ionospheric disturbances.

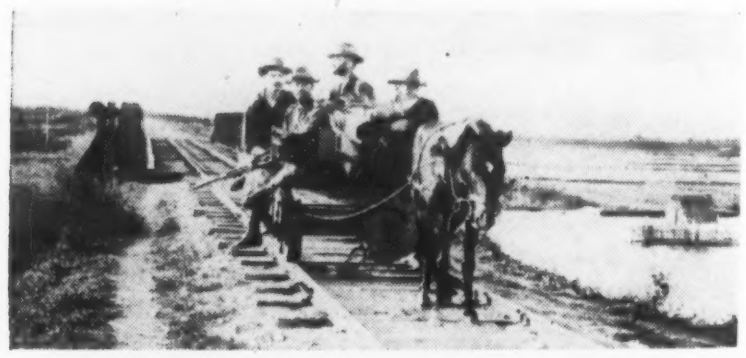
Broadcast coverage to Fleet units will soon be greatly extended when the U. S. Naval Radio Station, Cutler, Maine, is activated. This VLF transmitter is one of the largest and most powerful in the world. Along with the VLF facilities at Jim Creek, Washington and Annapolis, Maryland, it will extend and improve this type of coverage to Fleet units operating in Northern latitudes.

The ever changing complexities of Fleet operational requirements dictate an aggressive program of improvement in the Naval Communication System. Most of the new efforts in Naval Communications are undertaken to provide the Navy increasingly better service with emphasis on the traditional requirements for reliability, security and speed, now accentuated by the space age. In addition to the advanced communication techniques and fabrication of equipment already employed, automatic switching for both radio and landline circuits is to be extended overseas; point-to-point and ship/shore circuits will be further multi-channeled, as well as the broadcast circuits to the forces afloat which will also receive multi-channel equipment. Radio transmission and reception quality will be greatly enhanced by the advent of a satellite relay system on a common user basis. Transistorized equipments are soon coming into general use and will provide great advantages in space saving qualities and maintenance upkeep problems.

In order to effectively operate the Naval Communication System during these days of rapid and complex advances, the need for specially trained high caliber people is urgent. General and specialized training courses are provided by the Bureau of Naval Personnel, supplemented by courses afforded by several training commands. In addition, training in certain types of equipment is provided by the manufacturer. It takes intense specialized training, education on the post-graduate level and varied practical experience in communications for Naval personnel to keep abreast of the present-day requirements and future developments in communications.

The tempo of Fleet operations today is faster than ever before in peacetime history. With heavy commitments throughout the world, the Fleet commanders face an enormous task in deploying their units to meet all requirements and in readying them for any contingency. The complexity of modern weapons, the speed of modern aircraft and missiles, plus the dispersal employed over great ocean areas require rapid and voluminous communications if the commanders are to effectively employ their forces. The broadening of the command concept under combined, unified, and specified commanders requires a most reliable communications system in order that the various commanders may exercise coordination and command control within a minimum time span. The Naval Communications System is considered an integral part of many naval weapons systems and of combat operations. It has experienced many changes over the years and is rapidly undergoing change today. However, the objectives of all changes in Naval Communications are to insure that more reliable, more secure, and faster communications are provided to the commander in order that he may command most effectively.

. . . on a hand-car during the Philippine Insurrection



. . . in the trenches during World War I

. . . on the outskirts of Clark Field, Manila, during WW II

official u. s. army photographer

by

ANNE MELSON STOMMEL

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IN ANY DISCUSSION of signal photography today, a distinction must be made between civilian-type photography and military-type photography. Both types are performed by the U. S. Army Signal Corps in rendering pictorial services to the Army in peacetime and in wartime; but the military-type is designed primarily for wartime use.

Civilian-type photography is coverage of newsworthy military functions and operations for public information, historical, or documentary purposes. The term civilian-type also applies to identification, portrait, medical, legal, and a host of additional kinds of miscellaneous photography. Such photography is termed civilian-type because the techniques used are similar to their civilian or commercial counterparts. It is functional and serves the Army in numerous ways; but, if it had to be, the Army could do without many of its aspects —particularly during combat operations.

Military-type photography has no civilian or commercial counterparts; and it is a basic ingredient in the process of winning battles. It supports G2 (Intelligence) and G3 (Operations) by permitting the dissemination of vital pictorial information to combat units —on such matters as terrain, routes, and road conditions —and assists commanders in arriving at sound decisions. It supports artillery and rocket units by pictorially recording the effects of fire and other conditions pertinent to the performance of these arms. It supports all types of technical intelligence teams by providing pictorial recordings or interpretations of enemy areas, equipments, and facilities. It helps military intelligence teams by providing coverage that supports interrogation work or order-of-battle research. It helps U. S. Army Corps of Engineer troops in need of visual data necessary for planning and operations. It helps the photograph interpreters of G2 sections who may need special ground or aerial coverage to supplement Air Force, air reconnaissance unit, or drone coverage that does not meet with existing requirements or fails to pin-point specific targets in sufficient detail. It also serves psychological warfare activities—a highly specialized field constantly in need of hard-to-obtain pictorial material.

To make a conservative estimate, when signal photography is properly employed within a field army during wartime, 75 percent of the photographic missions belong to the military-type category. A large segment of the military sciences is deeply involved with the need for, and ways of obtaining, information about the enemy.

The G2, who must collate and convert this information into intelligence, leans heavily on all channels of information open to him. Success in military intelligence is closely associated with the ability to increase the number, quality, and scope of available information sources. For this purpose, the G2 has various teams of specialists, trained to extract information wherever it appears appropriate. While he has a photo-interpretation (PI) team, trained to analyze aerial photographs produced by the Air Force and division aerial reconnaissance units, the G2 does not have a photographic team which could supply him with the type of detailed visual information he may specifically require.

To obtain ground photographs of an almost unlimited array of subject matter, intended to supplement and expand collected information, the G2 must rely on the signal photographer—the Official U. S. Army Photographer. The signal photographer also uses light army aircraft to provide specific coverage that is not available through the use of automatic aerial cameras in special aircraft or in remote radio-controlled drones.

Today, we could no longer report, as was done in 1913, that cameras were issued and "every signal officer in the field became a photographer." Pictorial information aids today's command decisions and assists future military operations only if the military cameraman records essential features of terrain, enemy strongpoints, captured personnel and equipment, or similar items. Military cameramen can know what to record only if they have been thoroughly trained in military information collection procedures; if pictorial officers are versed in military science as well as in the "mechanics" of photography; if military schools, instructors, and training literature emphasize the military requirements of photographic coverage; and if research and development laboratories concentrate on devices that embody practical characteristics that are applicable to tried and proven military situations. Today, signal photography is a science.

Regardless of their obvious public interest—or unexpected military value—early efforts in the field of military photography were "hit-or-miss" affairs. The first photographs of United States military activities were those made by Matthew Brady during the Civil War. But Brady was a civilian who followed the Blue and the Gray on the battlegrounds, recording their activities for posterity. The first public awareness of photographs made by soldiers in actual combat can be dated from the Pan-American Exposition of 1901 at Buffalo, New York, where such photographs were exhibited. A Signal Corps photographic detachment accompanied General Arthur MacArthur during the Philippine Insurrection that broke out on 4 February 1899 under the rebel Aguinaldo. At one time, after the Americans captured a narrow-gauge railroad—including some locomotives, passenger coaches, and freight cars—a handcar was reserved for the use of the photographic detachment; and it provided welcome transportation for the bulky cameras, tripods, and accessory supplies of the period. The film that came pouring in from the Philippines was processed in a temporary laboratory in a room set aside as a photographic studio at the Signal School, Fort Myer, Virginia. Many of the resulting photographs became famous at the Buffalo Exposition. During 1913, the Signal Corps made its first motion picture at the camp of a cavalry brigade near Winchester, Virginia. Shortly afterward, the Chief Signal Officer notified the War Department that henceforth it would be possible "to present for inspection at any post possessing a kinematograph projector. . . animated pictures of all new formations and evolutions of this command." This was the period when cameras were issued to signalmen, and "every signal officer in the field became a photographer," with orders to forward each roll of exposed film to Washington for developing and printing.

Prior to the Battle of Cantigny, in the spring of 1918—as a contribution to the over-all plan—a division photographer crept out into No-Man's-Land and returned with pictures of the enemy's line and the terrain just back of it. His film was processed and printed and—for the first time in history—photographs became a basis of study by infantry platoon commanders.

When troops of the AEF were assembling in France—preparatory to their engaging in World War I—General Pershing had said he would want a permanent, photographic record of the fighting; and he issued a directive that assigned the job to the Signal Corps. Though photography had been a Corps activity since 1881, it was not until 1917 that the photographic mission was, by Pershing's order, assigned to the Corps officially.

In 1960—the one-hundredth anniversary of the United States Army Signal Corps—signal photographers, on peacetime assignment, wear an ultramarine blue brassard on the left arm above the elbow. This brassard has the word "photographer" in golden orange letters. Thus, whenever "U. S. Army Photograph" appears in the credit line beneath an illustration—in a newspaper, magazine, or similar publication—we have evidence of another job well done by members of the Signal Corps.

The Official U. S. Army Photographer of 1960 has a two-fold mission. Part of that mission is not unlike that of his civilian counterpart—the news photographer or pictorial journalist. The other part—the military-type—has become a pictorial information-producing activity based on essential elements of information (EEI) and formulated in accordance with coordinated decisions of the G2, the signal officer, and the assigned pictorial officer.

USAF Dedicates

(*Continued from page* 28)

tion, the superviser can ascertain, by pressing a button, which cross office connections are established at any given time; establish alternate routing; and route traffic to a spillover or local position in the event of channel outages. The supervisor, or control console attendant, also is in constant communication with all sections of the station by intercom. Hence, he serves as the coordinator between the various sections, and insures that all troubles are reported to the appropriate agency for action. A voice coordination circuit interconnecting all of the Continental United States switching centers is also terminated at the control position. From here, the controller may contact his counterpart at the other centers, or he may refer a problem to the over-all net central station, the Channel and Technical Control Agency at Scott Air Force Base, for final resolution.

Since it is necessary on occasions to exchange message traffic between switching centers, a number of standard, automatic send-receive teletype printers are provided at each center. These terminations provide for exchange of company business, or service messages. Additionally, a position is provided in each station for the semi-automatic dissemination of general messages, that is messages addressed by means of a single abbreviated title, to all tributaries of a given center.

Thus, the Plan 55 is now handling a large portion of the Air Force communications business. In the handling of traffic within the United States, 97% of the total is handled within thirty minutes. The goal of fifteen minutes handling time from originator to addressee for Operational Immediate Precedence messages is within sight. The number of relay centers has been reduced from thirteen to five, and the trunk circuits from seventy-five to forty-one.

The Plan 55 provides 100 WPM operation between relay centers and 200 WPM cross office transmissions within each center. All this has been done with a decided reduction in operator personnel. One additional significant factor is the added capacity for expansion in the system.

However, the Plan 55 is only a step in the development of systems which have been employed in our constant endeavor to carry out the communications mission of the Air Force. Refinements in communications continue and new methods and procedures are continually being sought to better provide a variety of rapid, reliable, and secure service.

The U.S. Army... 100 years of combat surveillance

1860 *First aerial combat surveillance for direction of rifle pits and cannon fire during the Civil War.*

1960 *First unmanned surveillance jet for acquiring tactical missile and other weapon system targets.*

Just a hundred years ago, the U. S. Army Signal Corps was established with an appropriation of $2,000 to "manufacture or purchase . . . apparatus and equipment for field signals." On June 21 of that year, Albert James Myer was appointed Signal Officer with the rank of major.

One of the Signal Corps' earliest successes was the world's first surveillance from the air — by means of Professor Thaddeus Sobieski Coulincourt Lowe's balloon, which was used to observe Confederate troop positions during the Civil War.

Indicative of the Signal Corps' tremendous progress in pursuing its assigned mission is the SD-5 — its newest "apparatus and equipment" — being developed as one member of a family of surveillance drones for the Army. Fairchild is proud to serve as systems manager, working with the U. S. Army Signal Research and Development Laboratories and the U. S. Army Combat Surveillance Agency, in the development of this advanced surveillance system. The jet drone air vehicle and ground support elements are the responsibility of the Fairchild Aircraft and Missiles Division. The electronics and guidance and control system are the responsibility of the Fairchild Astrionics Division.

FAIRCHILD

ENGINE & AIRPLANE CORPORATION, HAGERSTOWN 10, MD.

by THOMAS MELOY
President, Melpar, Inc.

REPORT ON U.S. ARMY SUPPLY OPERATIONS IN THE COMMUNICATIONS ZONE IN EUROPE

NAPOLEON IS SUPPOSED to have said that an Army marches on its stomach. It also marches on the proper Quartermaster supplied boots and clothing, rides in proper Transportation Corps vehicles, carries gasoline and sufficient ammunition for its guns—ammunition that fits the guns. It is possible that more battles have been lost because of an inadequate supply system than for any other reason.

I had heard many things about the handling of U. S. Army supplies; some of the comments extremely critical, others complimentary. I had seen, as have many others, supplies dumped in varying states of order. Therefore, I was happy to take advantage of an invitation to visit the supply operations in the Communications Zone in Europe, located in France. These supply operations, exclusive of ammunition, are directed from Headquarters at Orleans. I am also happy to make the following report on what I observed.

How the Army handles its vast supplies has always been a major concern, not only to the Army, but also to the American people as a whole. The enormous quantities of supplies, the evident and understandable wastes in war, the easily aroused suspicions of neglect, the frequent publicity about mistakes in buying, fortunes made out of supplies, and Congressional investigations, keep the subject alive.

There is much about the military that the public and Congress can grasp easily. They can appreciate the tremendous investment represented by massive concentrations of trucks, tanks, earth-moving equipment, tents, clothing, and food. They can see these items and estimate their value. Rusting equipment, rotting supplies, and spoiled food are words with meaning to everyone.

Because of the war time image of waste and destruction, and because of the other factors noted, there is a tendency to believe the Army may be lavish with its funds: that vast sums of money—represented by taxes—are lost. Waste is something that costs a nation money, whether it be public or private.

I do not propose to go into detail of how decisions are made as to amounts of supplies and their disposition. These decisions are based on complicated logistic studies, and are governed by such factors as availability, source, transportation, budgets, and the vagaries of possible wars and disasters. The ordering and disposition of inventory for the military forces are based on some of the same principles as are the inventories of any commercial business, except that the Army inventory must be larger than any commercial business in the United States. Some of the factors which must be taken into consideration are sometimes different from those considered in a commercial business. The Army's responsibility for the maintaining of supplies in Europe is one of the essential foundations of the NATO system, and of our European defense system.

Many of us are familiar with the vast supply dumps that extended for miles after World War II. The amount of supplies in Germany after the war was colossal, as can be imagined. When the Korean situation began and Europe was threatened, it was essential to move these supplies to a rear, or Communications Zone. The decison had to be made quickly. The zone assigned to the American Army by France was centered around Poitiers. This is an area from Orleans in the Northeast, and Saumur, Chinon, Ingrandes, and other general depots as far south and to the west as Bordeaux. The ports assigned for supplies were St. Nazaire, LaRochelle, and Bordeaux.

The exigencies of the crisis in Europe were such that the supplies had to be moved within a few months and literally dumped on the ground for want of other preparation. This ground dumping is one of the special problems with which the military has to contend. Various caves along the Loire River were used for quantities of Quartermaster and Signal Corps equipment, while trucks, tanks, earth-moving equipment, bridge building equipment, etc., had to be left in the forest and on the ground.

Today, several years after this emergency, this depot supply complex has become a well organized and adequately housed operation.

The Army should not be criticized for the lack of preparation for this move. Conditions change rapidly. The decision had to be taken immediately. We live in an age of constant tension, different kinds of tensions. Sometimes it is easy to forget the

conditions existing when the Korean War came upon us, and the preparations for what appeared to be the possibility of all-out war. The sudden realization of our weakness and our danger made the move an almost overnight decision.

The improvements in the handling of the supplies since then are extraordinary. The three segments of this complex, which I visited—Engineer Corps, Quartermaster and Signal Corps—are housed, and now have a good working facility from the source of equipment at the ports, to all of the defense and prospective defense theaters.

The Signal Corps Depot at Saumur is able to maintain all the various types of electronic and communications equipment—radio and radar, walkie-talkie, direction finders—used by the Army. The Signal Corps is the nerve system of the Army, transmitting information from its various sensory units to Command Headquarters, and transmitting them for action to its numerous divisions. It is estimated that in the human body there are over a billion neurons, which take information to the brain for evaluation, and then transmit command information to the muscles for action. There are not a billion neurons in the Signal Corps Depot at Saumur, but there are hundreds of thousands of items.

At the Depot are shops capable of assembling, testing, repairing and rebuilding the electronic communications gear. These include machine shops, coil winding shops, battery storage, insulating equipment and refrigeration.

Americans have always been profligate of their great resources. During the last war the American forces were criticized for abandonment of and lack of care for equipment. The reverse is true at Saumur. Millions of dollars are being saved by repairing and rebuilding equipment.

Depot at Chinon

At the Depot at Chinon there are thousands of acres on which are located every type of road building equipment, earth-moving equipment, bridge building equipment, trucks, tanks, compressors, generators and, in general, the materiel of the Corps of Engineers. The Depot is rebuilding trucks, earth-moving and electrical generating equipment; much of it dug out of the mud where it had been dumped on the ground during the crash program of relocating the supply complex. The reclaimed equipment is sent back to the Commands for further use.

The inventory is subject to constant inspection to prevent deterioration, and to keep it in combat readiness. It is very fortunate that these facilities are available. The Army would not have road building and earth-moving equipment, trucks and tanks unless they did rebuild them. Appropriations to buy new equipment have been drastically cut.

The question whether to rebuild or to cannibalize is a problem common to all the Technical Army Services. The formula adopted is the sum of the obsolescence, plus the cost or availability of parts. When the sum of these two factors reaches a set level, the equipment is set aside so that its parts may be used for equipment still in the field.

I think it would be interesting and beneficial for contractors to tour the Chinon Depot. In my opinion, the maintenance of such equipment by the Army is more efficient than our commercial practices in this country. If earth-moving and road building equipment were maintained as conscientiously as is being done by our Army in France, it might be a blow to manufacturers of earth-moving equipment, but it would probably save a great deal of money in building construction.

The Quartermaster Depot at Ingrandes also has its shops, its test equipment, its moving equipment. Its operations are carried out with "spit and polish" housekeeping. Military "spit and polish" performance is important for the preservation of supplies. The Quartermaster Corps has a vast number of functions to perform and equipment to purchase, and needs constant vigilance and attention to organization.

Food Problems

There is food. Food presents considerable problems since it is shipped from the United States in various types of vessels, not necessarily equipped for the handling of unit shipments. At the docks in France the food is transferred to railroad cars and trucks not entirely compatible with the types used in the United States. Frequently supplies arrive in broken lots, and in various stages of damage, and in varying periods of time, not related directly to the date of shipment. The Corps has been criticized for sending new shipments of food, before using up supplies previously received. Improvements have been made, especially in identification. The module system of storing boxes, and new classifications by size and nature have overcome most of the difficulties.

The Quartermaster Corps is charged with supplying and maintaining stoves, refrigerators, dishes and pans; along with shoe repairing, dry cleaning, baking, and laundry equipment. It also must order, maintain, and distribute clothing, shelters, tentage, and just about everything that has to do with living and dying, from birth to the grave, including embalming, the graves and the monuments.

The supplying of clothing and shelter equipment is complicated by the fact that these items must meet different requirements, such as the four seasons, for different theaters of operations, varying from the semi-polar regions in Norway, to the Mediterranean, and such spots as Lebanon, the Persian Gulf and the Sahara. The clothing must also fit different types of soldiers, foreign and American. Shelters and appropriate supplies must also be maintained for civilians to provide for disasters and/or refugees. The supplies must always be in readiness, and thus have to be constantly inspected and protected against deterioration.

Inventory for Readiness

In general, the Army must maintain an inventory in readiness for requirements in peace, in partial war, and in full war. The supplies must be available for shipment wherever they are needed and immediately. The demands of emergencies, such as Suez and Lebanon are examples of what the supply depots may be called upon to meet.

The Depots take advantage of accounting machinery. Records are kept on punch cards, magnetic tapes and by computers. The inventory is current in terms of quantity, nature and function.

A special transceiver information processing system is used, by which requests for supplies can be made by any of the various units of the Army in the field, transmitted to Headquarters at Orleans and directed to the supply depots. The order is acknowledged and the shipment made with simultaneous recordings at the headquarters of the depots and at the using Army units. The resulting changes in the inventory and supplies are also recorded. Thus there is a live record of orders, shipments, receipts and stocks. The divisions in the field are proud of the transceiver system. It effects savings in time and money, since accurate, timely knowledge of inventory, shipments, requirements, make it possible to get along with a smaller inventory.

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INDUSTRIAL FORCES IN SCIENCE

by SAMUEL LENHER
Vice President and Director, E. I. du Pont de Nemours & Company

PART II

Synopsis Part I: The development of the basic relationship between science and industry, and how this relationship has affected our economic growth was the subject of Part I, which appeared in the May issue. Mr. Lenher traced the history of the support of scientific endeavor and discussed industry's turn to science in its search for ways to operate at a profit.

NO EXAMINATION of the effects of the science-industry partnership should overlook its tendency for self-perpetuation. There is such abundance in the United States today that, except during the downward swings of economic cycles such as that we recently have passed through, the vast majority of the people are able to indulge in discretionary spending. That is, after providing for food, clothing and shelter, they can buy television sets, radios, or household appliances, improve their home, get a new car, eat more richly or shop for a new gown. Or, of course, their choice might be to put the money into a savings account, an insurance policy or invest in a security.

Consequently, the manufacturer not only must utilize science to keep ahead of—or at least keep up with—his direct competitor but he must also enlist science to help win the patronage of the discretionary spender. Today's consumer can choose between the purchase of a new automobile or an air conditioner. He can select oak flooring or a variety of plastic tiles for the new house. In clothing, he can appraise the relative advantages in quality, as well as price, of the natural fibers, such as cotton, silk and wool, along with the new synthetics including nylon which became available only 20 years ago. Steel has a competitor in aluminum, as well as wood, in a variety of uses. With credit to O. Henry's famous short story, the choice could even lie between a watch chain for the husband or an ornamental comb for the beautiful hair of a wife.

To manufacture and sell profitably, the businessman must provide a product which is more attractive to the customer than other products available. He tries to do this by developing a new manufacturing process so as to lower the price of an existing product or by offering a new and better product. In either case, he turns to his old ally—science—because experience has demonstrated that the most effective tool to help him with the favor of customers is research.

Not all companies in industry can afford to carry on their own research. Some rely upon the technical discoveries of government and academic institutions. Others belong to trade associations which conduct research programs for the benefit of all the association members. Still others assign specific research problems to a university or to private research organizations and institutes on a contract basis. There is a distinct and growing trend, however, for companies to have their own research programs, frequently in addition to contract work performed by universities and institutes.

It is estimated by the National Science Foundation, on the basis of latest available surveys, that industry today carries on about 70 per cent of all the research and development in the natural sciences and engineering in the United States. Federal Government carries out about 15 per cent and universities and others a little less than 15 per cent of research on a performance basis. This includes research sponsored by industry in grants to universities and independent research organizations, which amount to about 30 per cent of the funds spent for university research from non-Federal sources. Total research and development expenditures—Federal and private—were estimated at ten billion dollars in 1957, or more than three times the total for 1950, and in 1958, 1959 and 1960 research expenditures have increased further.

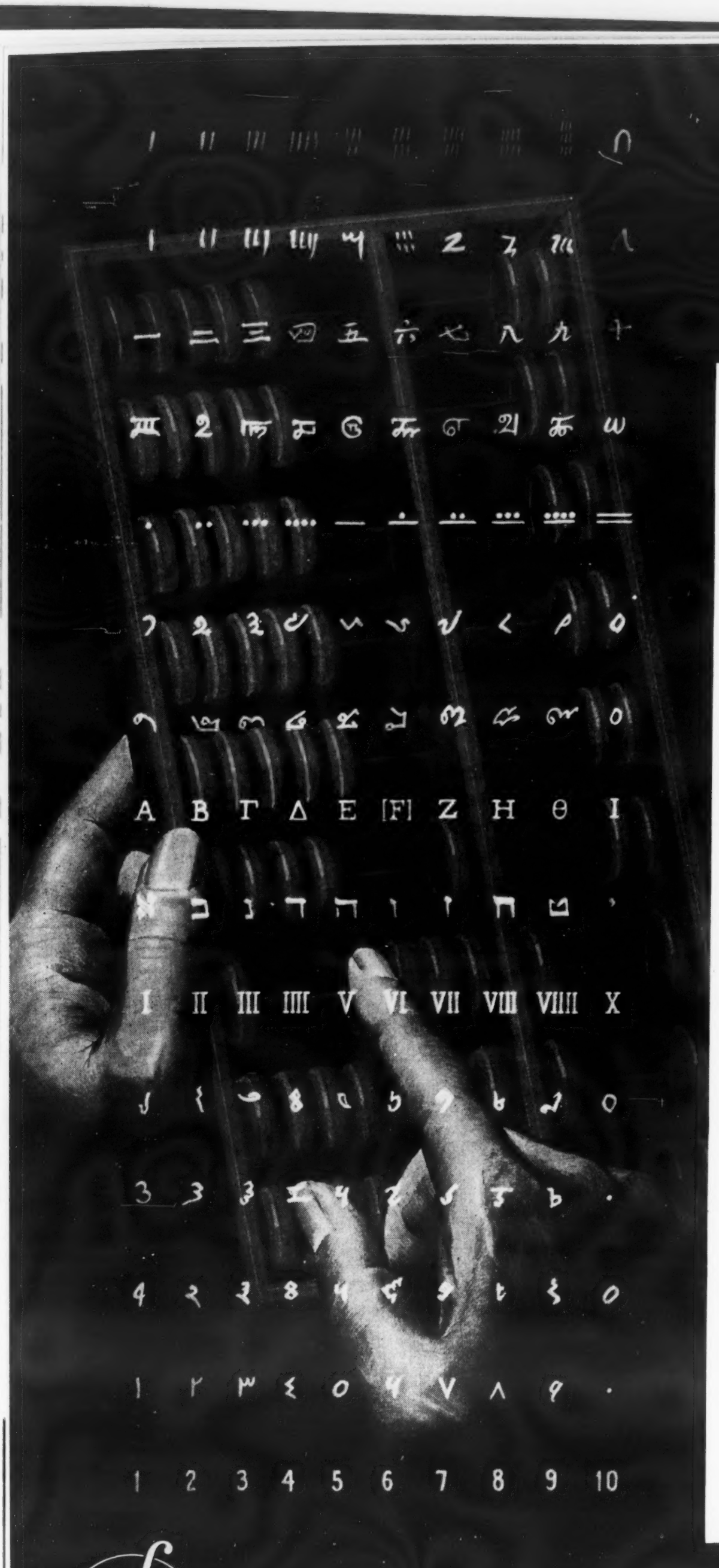
The Du Pont Company alone spent ninety million dollars, equivalent to over four per cent of its sales, for basic and applied research in 1958. This was in addition to an almost equal amount expended for technical assistance to production and sales, which would be regarded as research in some industries.

About four per cent of all industrial expenditures for research and development is for basic research or scientific inquiry which merely seeks new knowledge without regard to specific commercial applications. In some industries, such as the manufacture of chemicals and of electrical equipment, basic research accounts for as much as 20 per cent of the total.

Some of you may wonder how any company can justify substantial spending for research and particularly basic research. The justification and the incentive can be expressed in one word—profits. When there are no results contributing to profits, the stockholders have a right to ask management what is wrong. Over the years, businessmen have found that research—both basic and applied—pays off.

Let me cite the experience of the Du Pont Company. In 1927, it decided to undertake a modest program

(*Continued on page* 47)



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of basic research. An exploration into the field of long-chain polymers was begun, without specific commercial objective but still with the hope that some commercial opportunity might be presented. In the course of the experiments, the basic researchers came up with many new substances. One of these was recognized as having unusual fiber qualities by a scientist who was experienced in rayon chemistry. Many more years of research and development were required but the product was nylon, a commercial success.

Of course, among the vital problems which must be decided by those who administer industrial research is when to cut off funds for a project which fails to show results after reasonable time and effort and when to intensify the effort to seek a final break-through toward an objective which will be profitable because of its ultimate usefulness to society. Here I would like to emphasize again a difference between research in industry and in the university. Academic research is considered successful if it adds to knowledge in any scientific field, regardless of whether the knowledge will have a useful application. Industrial research is only successful when it results in information, in products or in processes which will be useful and therefore profitable to the industry in which it is developed.

Importance of Patents

In industrial research and development, an important factor is the patent system which confers exclusive ownership of a discovery on the patent holder for 17 years. The patent sysem has a dual purpose which is not widely understood. One purpose is to encourage the prompt disclosure of a discovery for the benefit of science and society. The second purpose is to enable the inventor to reap his share of whatever reward might be forthcoming from the commercial development and sale of articles based on the discovery, so as to give him an incentive to make available and not to keep secret, the basis of his invention.

If efforts to weaken the patent system should ever be successful, I am quite sure society will be the loser. Inevitably there would be delays in the commercial development of a new idea or process for it would only be natural for the inventor to conceal his secret until he could make sure of reward.

There would be less incentive for industry to engage in research or to risk the huge expenditures necessary for commercial development, if competitors could copy the innovation as soon as it appeared upon the market. Worst of all, the shadows of secrecy which would shroud the results of much scientific investigation would retard progress in both science and industry for very frequently the piercing of one barrier stimulates ideas and inquiries in other quarters which lead to even more important discoveries.

The objection sometimes is heard that most patents today which result from industrial research are taken out by companies or are assigned to companies as a result of agreements with members of the research staff. It is hard to understand why this can be protested as unfair or unwise when the discovery is made in a company laboratory by a scientist employed for this purpose. Moreover, it is generally the custom in industry to provide an added incentive for successful research by giving the individuals responsible for a patented discovery a fair share of the reward resulting from commercial development.

As we have seen, the impact of industrial forces in science has been of great significance in many ways but there are others which I should mention briefly.

First, these industrial forces have had a definite influence upon the direction of scientific research and development both in industry and in academic institutions. For example, organic chemistry and electrical and mechanical engineering have assumed much more importance with the growth and sophistication of industries requiring the use of these disciplines. Atomic energy and the problems associated with rocketry and space travel have stimulated greatly increased activity in metallurgy and solid-state physics.

Second, the competition among industries for trained personnel has tended to upgrade scientific teaching and training in colleges and universities. Industrial technology in practice is usually ahead of its exposition in teaching due to the time-lag involved in the feedback of information developed through industrial research and its application. Thus industry continues to challenge instruction by providing constant innovation and expanded application of science.

Third, the role of industry in focusing public attention upon science has considerable significance. The promotion and advertising of new products have done much to make the whole public aware of the existence and importance of science. Employment opportunities and the careers open in industry for young men and women with scientific training have had the same effect in bringing public recognition and support of science.

Prophecy is always difficult and it would be treading on treacherous ground to try to appraise the effect of industrial forces in science on the future. But I am reminded of a phrase carved into the stone exterior of the National Archives Building in Washington. It reads, "What is Past is Prologue." This is frequently interpreted by the capital's taxicab drivers as meaning, "We ain't seen nothin' yet."

A report of the President's Science Advisory Committee, entitled "Strengthening American Science," says in more dignified words, "The secrets and treasures of nature are hidden in the most obscure and unexpected places. It is clear, therefore, that the strongest scientific program is the program with the greatest breadth and scope. It is impossible to predict from which quarter the next scientific advance will come but we can try to make sure that the nation has able people at work across the whole scientific frontier."

Immediate Future

For the immediate future, one set of facts deserves attention. The volume of industrial research rose sharply when Korean War restrictions and discriminatory taxes on profits came to an end in 1953. The tax revision of 1954 added another incentive by making research expenditures deductable as a current business expense. There was a 40 per cent increase for research expenditures in manufacturing from 1954 to 1956 and another 20 per cent rise in 1957. While costs of research have increased, it is plainly evident that industry is working on more new products and new processes than at any time in history.

The significance of these facts is in their relation to another circumstance. A new product or a new process does not spring into being overnight. It takes an average of seven years, and frequently much longer, before an idea in the mind of a scientist can be translated into a successful laboratory experiment, be put through all kinds of tests, be brought along through the pilot plant and semiworks stages and finally result in commercial production.

For this reason, the new products and the new processes which we hope will result from the post-1954 research boom are unlikely to reach the consumer or even bring a surge in capital expenditures for new plants and equipment, until after 1960. The

next 10 years should be a thrilling decade, although, of course, there is no assurance except past experience that either the quantitative or qualitative results will be commensurate with the added research efforts. We can be quite sure, however, that the great expansion of research in the present decade is an important factor in the calculations of those who foresee in the next a prosperous era with a substantial further rise in living standards.

Pleasant as future horizons may appear, it would be unrealistic not to recognize certain social problems which have developed during the science-industry partnership. One of these is technological unemployment. The Luddites smashed and set fire to the early looms in the textile factories of England because they feared the looms would take away their jobs. The more refined sabotage of modern times is called feather-bedding, which simply means that employee groups with sufficient economic power can insist upon the employment of more workers than the number required for efficient operations after new technology is introduced.

The unsettling results of technology to specific individuals are nowhere so apparent today as in the coal mining regions. The development of efficient oil burners and gas transmission systems made these fuels competitive with coal in the market place. To meet this competition and to pay increasingly high wages won by a strong and aggressive union the coal industry turned to technology and developed mining machinery which enables six workmen to produce as much coal as 60 could produce by older methods. The result has been a painful period of transition for miners who have lost their jobs and have been unable to find other employment.

It should be pointed out, however, that the miners still at work receive extremely high wages and work extremely short hours. The beneficial result of technology, whether in farming or industry, is the upgrading of labor both in pay and in the type of work performed. There may be fewer opportunities for common labor today but the skilled and semiskilled artisans have opportunities which are more rewarding and the nature of their work is more attractive. Technology also creates employment. The automobile displaced the carriage and while the buggy manufacturers and the livery stables disappeared we have garages, filling stations, hot dog stands, motels and road-building as well as automobile factories. Coal-oil lamps are seldom seen except in the antique shops but millions are employed in the production and distribution of electricity and its appliances. Leisure and higher incomes have stimulated a tremendous expansion in the service trades.

The trend is unmistakable. There has been a shift of farm labor to industry, from one form of industry to another and now from industry to the service trades. The problem which confronts every group in society is whether anything can be done to make this transfer easier for the specific individuals affected. It is a problem which will require patience, cooperation and understanding, for no easy solution is apparent but I am confident that human intelligence will find a way.

Role of Corporations

I am less concerned over what some regard as another social problem resulting from the partnership. This is the rise of large corporations or to use what seems to have become a derogatory term, "big business." It is contended that large corporations stifle competition because of what is presumed to be their economic power. The facts are that corporations become large because they compete vigorously; they have grown because the public thought they performed useful services. The large corporation fills a needed role in society when it undertakes research, builds great plants or provides services which demand large sources of money and manpower for achievement.

Another version of the attack on bigness is the accusation that it imposes conformity upon all who work for large corporations. But as we have seen, the essential difference between the large and the small enterprise is the number of people engaged in the cooperative effort. The successful employee in industry is the originator, the man with new and successful ideas. In the Du Pont Company, there even is provision for a bonus reward to the employee who persists with a successful idea until it prevails over opposition within the organization.

A related problem, however, is very real. Science and industry have become so complicated, requiring so many different talents, that group effort is the rule rather than the exception. The lone inventor today frequently needs the help of the chemist, the physicist, the metallurgist, the electronics engineer, the mechanical engineer and many others. Since there is a tendency for everybody's business to become nobody's business, the problem is to keep the spark of individual initiative bright, for virtually every successful achievement begins as an idea in a single mind.

Some concern also has been expressed over whether industrial scientists really have enough freedom of scope in their problems to be productive. Doubtless it is true that the scientist who wants to do exactly as he pleases should be in an academic laboratory, although I doubt whether even there his freedom will be absolute since he still has to contend with deans and boards of trustees. But it also is a fact that industrial research scientists have a wide scope in which to work on problems within their fields of activity. Alert industrial management does not allow scientific talent in its organization to be regimented, held unproductive and have its potential help go unused. On the contrary, industry which employs scientists and engineers aims to profit from their expert services wisely used. A company which wastes scientific skill in its organization quickly loses financial and professional standing.

There still are responsibilities to be met by the universities, the professional associations, government, industrial managements and research administrators. The most important is the discovery, the encouragement and the adequate training of the outstandingly original scientific investigator and the fostering of his work. We must develop the sensitivity to detect the innovating mind and provide the climate where it will be most effective.

We are surrounded by a richness of opportunity which has never before existed. An ever-growing number of fine minds are devoted to science and every significant innovation suggests new possibilities for exploration. If we can establish and maintain satisfactory human relationships —if we can remove the impediments to communication and understanding —we may be on the brink of an intellectual revolution.

The basic fact about industrial forces in science is the partnership of science and industry in advancing human welfare. Each complements and supplements the other in meeting their roles in our technical culture. The social problems which have resulted from industry's fruitful use of science are insignificant in terms of our whole society as compared to the benefits.

John Walden Myer, grandson of Brig. Gen. Albert J. Myer, First Chief Signal Officer, turns over to the Signal Corps Museum General Myer's field bible and first diary. Presentation is made to Miss Helen C. Phillips, chief of the Museum, with Major General Ralph T. Nelson, Chief Signal Officer, attending the ceremony. The General's grandson also presented the Signal Corps Museum with almost 1000 other papers and documents of the First Chief Signal Officer.

The Signal Corps Museum

by Helen C. Phillips
Director, Signal Corps Museum

ANNIVERSARIES CAN be empty occasions without the tangible objects that give added meaning to bygone days. During this year of the Centennial Celebration of the United States Army Signal Corps, the Signal Corps Museum is playing a significant role in graphic presentation with such special displays as "A Century of Photography," "Signal Corps Uniforms 1860-1960," and "Wigwag to Vanguard."

As the nucleus of its permanent exhibits, the Museum features the Brigadier General Albert J. Myer memorabilia which his heirs donated to the Signal Corps in 1942. Myer filled the position of Signal Officer which Congress authorized on 21 June 1860, a date which has been established as the birthday of the Signal Corps. And Myer became the first Chief Signal Officer in 1863 after Congress formally established a corps for signaling—the United States Army Signal Corps—today the oldest military signaling organization in the world.

The inspiring mementos of Myer's life include approximately 3,000 pages of his personal and official papers which range from his commissions signed by three presidents of the United States—Franklin Pierce, James Buchanan, and Andrew Johnson—down to his semi-weekly champagne bills at Fort Defiance, New Mexico; his red, white, and black muslin wigwag flags; his wooden-barreled, brass-bound telescope; daguerreotype and stereoscopic photographs; the hat and epaulets of his dress uniform, his sword and saber; early manuals of signaling and official reports of the Signal Corps, as well as original copies of the five editions of his book, *Manual of Signals*, the first of which was published in 1864 and the fifth edition in 1879. Prepared for use by signal officers in the field, this book proved so successful that approximately 5,000 copies were sold.

The Museum has developed an unusual collection of military communication items, with emphasis on equipment and documents pertaining to the Signal Corps. From a small exhibit assembled by World War I veterans, first displayed in the late 1930's, the collection grew to include memorabilia from the Civil War, the Spanish-American War, both World Wars, and the Korean conflict.

For many years there was an awareness throughout the Signal Corps of the need for a central collection point from which to direct a search for memorabilia of Signal Corps interest and historical significance and to provide a repository for them when they were found. It was natural to collect and preserve historical materials that reflected the achievements of the Corps in all wars of the Nation, and throughout the years of peace. Fort Monmouth—the home of the Signal Corps—seemed the most logical location for such a Signal Corps Museum and steps were taken to establish a home for the collection.

In November 1954, the Chief Signal Officer, Major General George Back, granted approval to redesignate the Signal Corps Center and Fort Monmouth Museum as the Signal Corps Museum. In that same month general orders

were published by Headquarters, Fort Monmouth, to implement General Back's directive.

Coincident with this official recognition, a permanent building was provided to house the historical items already accumulated. The move to a fourteen-room, red brick structure was completed early in 1955, and the exhibits were arranged in a generally chronological scheme.

On 31 May 1955, the Signal Corps dedicated its Museum—Armstrong Hall—in honor of the late Edwin H. Armstrong, pioneer in the development of radio communications, who at the time of his death in 1954 was Professor of Electrical Engineering at Columbia University, New York. At the ceremony, Major General Victor A. Conrad, then Commanding General, Fort Monmouth, gave the welcoming address; and Major General James D. O'Connell, Chief Signal Officer, the dedicatory address. Mr. Harry Houck of Measurements Corporation, Boonton, New Jersey, past president of the Radio Club of America and a close friend of Major Armstrong's since their World War I days at the Signal Corps Laboratory in Paris, unveiled the memorial plaque.

As stated officially, the mission of the Signal Corps Museum is to collect, maintain, and conduct research on paintings, pictures, maps, flags, weapons, trophies, relics, equipment, and other objects which are of historical significance to the Signal Corps and to act as the official repository for such items. The permanent and temporary exhibits not only serve as a medium of stimulating esprit de corps and enhancing public relations; the Museum also loans items for instructional purposes upon request of other military installations.

The oldest items in the Museum's exhibits are those used by the first permanently employed marine observer along the Atlantic Coast, whose earliest records are of the 1830's. His copy of the *Telegraph Dictionary and Seaman's Signal Book* is dated 1845. In 1853, he established an observation station at Highlands, New Jersey. He and his descendants operated this station until 1934, when it was torn down.

A pictorial display, original manuscript letters of Cyrus Field, together with a piece of the cable, graphically portray the completion of the first Atlantic cable in the Bay of Bull Arm, Trinity Bay, Newfoundland, on 5 August 1858.

In addition to the Myer memorabilia, other Civil War equipment includes a magneto electric signal telegraph, manufactured by George W. Beardslee, and patented by him in 1859, together with contemporary engravings and newspapers which illustrate its method of operation and labors of the linemen who ran out the wire.

The Spanish-American War exhibit is particularly interesting in the study of the Signal Corps crossed flags and torch insignia. The Museum has acquired the only known copy of the original authorization of the insignia in 1864 and is constantly supplementing its collection of signal heraldic devices. The uniforms, gloves, canteen, knapsack, and other accouterments of the 1890's are all embellished with crossed flags and a torch. Also shown are a field telephone used in the Battle of Santiago, Cuba; the Spanish Flag taken down from the wall of Manila, Philippine Islands, by Sergeant George S. Gibbs, Jr. (later Major General and Chief Signal Officer) on 13 August 1898; and the American Flag carried by signalmen in Puerto Rico.

A complete heliograph used by the Signal Corps about 1900, with the original technical manual and photographs, demonstrates heliograph signaling.

The Alaskan Cable System is represented by charts showing location of its cables and telegraph lines, and by about twenty of its more important items of equipment, together with the log of the cableship, USAT *Burnside*.

Museum exhibits include flags, photographs, and documents from the collection of Major General Adolphus W. Greely who as a first lieutenant—in the 1880's—commanded the ill-fated Greely Expedition to Lady Franklin Bay, in Grinnell Land, across the strait from Greenland. As Chief Signal Officer—in the early 1900's—Greely planned and supervised the construction of the Washington-Alaska Military Cable and Telegraph System that came to be known as WAMCATS.

Among the inventions displayed are those of Major General George O. Squier—the "scientist in uniform" who became Chief Signal Officer during World War I and who laid the groundwork for the U.S. Army Signal Research and Development Laboratory. Armstrong's inventions—the regenerative amplifier, 1912; superheterodyne receiver, 1918; and second harmonic superheterodyne, 1923—are highlights of a large collection of radio equipment used by Major Armstrong and later donated to the Museum by his heirs.

The Museum has separate exhibits of World War I American equipment and the signal apparatus of foreign armies in that war.

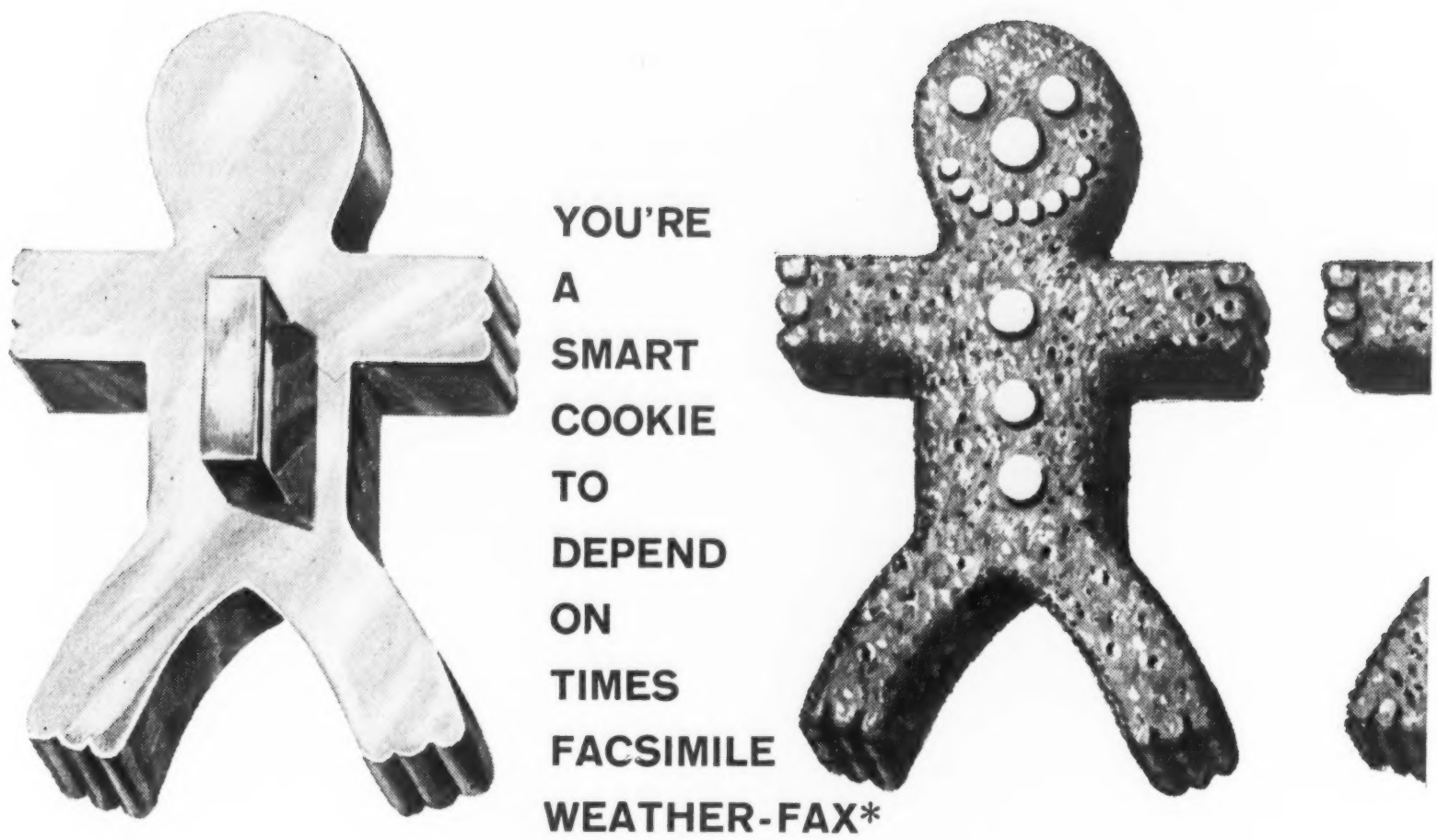
From the World War II period, very little has been acquired because the first requisite of historical properties is their obsolescence. Unless associated with a particular individual, place, or event of importance, current equipment may not be shown. However, a display of pigeon gear, and another of mementos from foreign armies, are representative of the 1940's.

Captured North Korean equipment and signal items from Antarctica draw interesting comments from many visitors.

Field telephones, radio tubes, meteorological instruments, and photographic equipment are each presented in a separate chronological development. In the last two areas mentioned—meteorological and photographic—there is a distinct need for obsolete items. Especially wanted are the De Brie motion picture camera, a 6½" by 8½" Cycle Graphic, a postcard-size roll film Graflex, and a khaki leather-covered folding postcard Kodak. The Museum is also seeking early meteorological equipment, for the meteorograph of 1929 is its most remote item. Anyone having knowledge of the existence of such equipment can contact the Museum, or better still, simply forward the equipment to the Museum.

The historical significance of items received by the Museum is evaluated by the Chief of Military History, Department of the Army, before anything is incorporated in exhibits by Museum personnel. In this evaluation, primary consideration is given to uniqueness and authenticity of the object, to its value in illustrating army life and operations—phases of the military history of this Nation—or to its association with some celebrated individual, place, or event.

As the Signal Corps enters its second century, it has a Museum that does more than enable visitors to acquire a better understanding of its history. In addition, every retired signal officer or enlisted man is assured of official interest in the manuals, photos, documents, and other gear that he may have accumulated as reminders of his military service; and of a permanent repository for those that will prove of value to others and to the United States Army Signal Corps in anniversaries to come.



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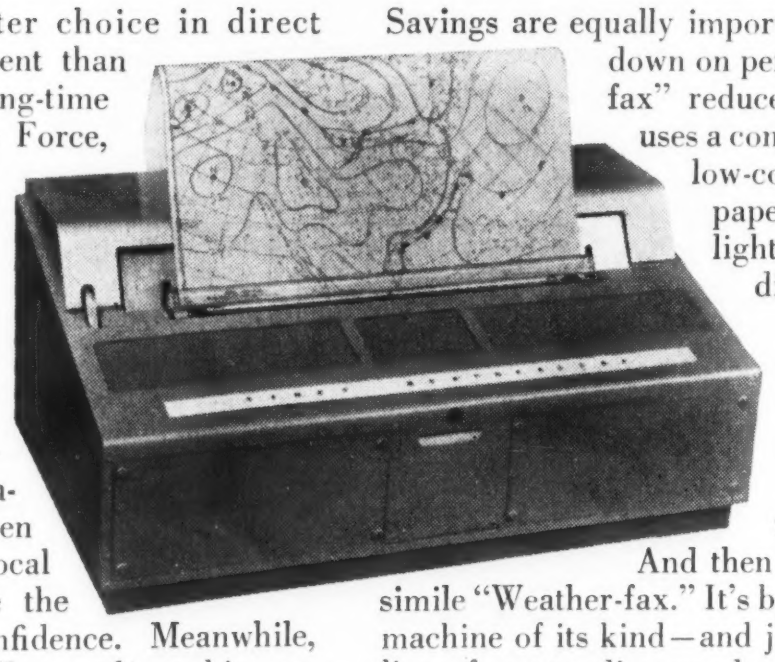

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PROBLEMS IN MILITARY SATELLITE COMMUNICATIONS

by

Albert D. Perry
Advanced Electronics Center
Light Military Electronics Department
General Electric Company

"THE SYNCHRONOUS-keyed signal . . . was hurled at the sky out of a reflector antenna by a thousand-kilowatt transmitter. It fought and it struggled . . . it lost heavily in the encounter. . . . It arrived at the relay station tired and worn.

"The signal, as weak and as wabbly as it was, was taken in. . . . It was amplified. It was dehashed, destaticed and deloused . . . one hundred decibels stronger and infinitely cleaner, the signal was hurled out on a tight beam . . .

"Across sixty-million miles of space went the signal."

G. O. Smith "QRM Interplanetary"
Astounding Science Fiction, 1942

". . . I have heard of very complicated transistorized code generators which will operate perfectly for years on end, of devices which will transmit good-quality speech using only 100 bits per second, and of devices which will recognize speech (not just a few words spoken in a few voices) and turn it into print. I know that all these things are as mythical as the Phoenix . . ."

J. R. Pierce, "Space Fantasies,"
IRE PGMIL *Transactions*, January 1960

The first of these quotations represents the rather careful development of space communications in the science fiction area; the second is part of a request that science fiction play a smaller part in descriptions of space communication as it will exist in the near future. On the other hand, Smith used a megawatt to send 11,000-word teletype to a station in a 500-mile orbit. As J. J. Coupling showed later in the same magazine ("Don't Write, Telegraph," *Astounding Science Fiction*, March, 1952), Smith the engineer should smile at the over-conservatism of Smith the science-fiction writer.

Today, although the technology has yet to produce any of Pierce's "mythical" equipment, it has already produced a space communication system, the Army's Project SCORE, which outperforms the Venus Equilateral fiction by thirty decibels or more. Unfortunately, as Pierce points out, highly complex real systems have yet to match the reliability of fictional systems.

Program

A General Electric team, under the direction of the Light Military Electronics Department's Advanced Electronics Center at Ithaca, N. Y., is currently engaged in a study which may loosely be described as an attempt to look ahead in space communication on the basis of sound extrapolation and innovation. This study, being performed for the Army Signal Research and Development Laboratory at Fort Monmouth, New Jersey, is concerned with the next generation of communication satellites, and with the generation after that, rather than with any one proposed system.

Its goals are:

To define the environment in which these satellites will operate. To outline satellite communications suited both to military operation needs and to the present and probable future state of the art. To develop the critical techniques involved in implementation of these systems, and to devise means of achieving useful performance with acceptable reliability.

This is a large order. Indeed, viewed in the strictest sense, it is one which can at best be filled provisionally today, only to open up again tomorrow as more knowledge and further innovations enrich each of its tasks. Continued success in the study will depend upon continued close integration with Signal Corps personnel, who have provided invaluable technical advice in addition to fiscal guidance.

System Requirements for Military Application

To be useful to the military, a communications system must have reliability commensurate with the importance of its function, as well as countermeasures resistance matched to the electronic countermeasures (ECM) attack which can reasonably be expected. Reliability is a major concern in any satellite system because of the present impossibility of physical in-orbit repairs. The potential importance of a high-capacity, long-haul military satellite communication system is great enough that excellent reliability is a simple essential. The importance of the system would also justify an antagonist's developing and using highly sophisticated intelligent countermeasures in an attempt to disrupt service at a critical time. Tradi-

tionally, in a high-performance system, reliability and countermeasures resistance have seemed to be incompatible. *In a military satellite system, they must be wed.*

Reliability

The first step in improving over-all system reliability is to assign as many of the essential system functions as possible to the ground terminals rather than to the satellite, in order to simplify the satellite electronics. One may accept moderate performance degradation in order to accomplish this simplification. The next step is to choose a system implementation which places a minimum burden on the remaining satellite equipment. This requires careful choices of modulation technique, operating procedures, and over-all systems layout. Finally, one turns to components and circuit selection. Here the standard rule applies: use good components and circuits, and use them conservatively.

Countermeasures Resistance

The countermeasures-resistance problem is as easy to state as the reliability problem. One must provide such a level of countermeasures resistance that it would be uneconomical for an antagonist to overcome it. A more careful look at the problem reveals a number of interesting items.

Since an antagonist would logically look for the weakest link in the system as the point to attack, one may not safely assume that the ECM environment will be, for instance, simple noise jamming.

Further, because the satellite is not a strictly passive device, it is not possible to make the standard assumption that the undesired signal simply adds to the desired signal.

Finally, a satellite which provides communication over a wide area of the earth is necessarily visible over a wide area. If, in addition, its life is usefully long, its signals are potentially available for searching observation and analysis, and the documents describing its characteristics are targets for espionage activities. All these items combine to make a problem more difficult—and more interesting — than those with well established information theory solutions.

Graceful Degradation

Another area of interest, bridging the ECM and the system operation areas, is associated with the term "graceful degradation." Although it is essential that the system perform adequately under maximum ECM attack, it is undesirable that it perform only this well when it is not under attack, because a less costly system could provide the same service under these conditions. An economically balanced system should provide service commensurate with its cost under all conditions. This requires that it provide very high performance under ordinary conditions, and gracefully degrade to minimum acceptable performance under maximum ECM conditions. It should do this without an unacceptable reliability penalty.

On the basis of the GE study, it appears that *the multiple goals of performance, reliability, and countermeasures resistance can be met.*

It is, of course, not permissible to state openly *how* they can be met. But the next generation satellite communication system can be a good military system. By applying more advanced technology, perhaps in part by using advanced redundant logic systems, succeeding systems can be excellent.

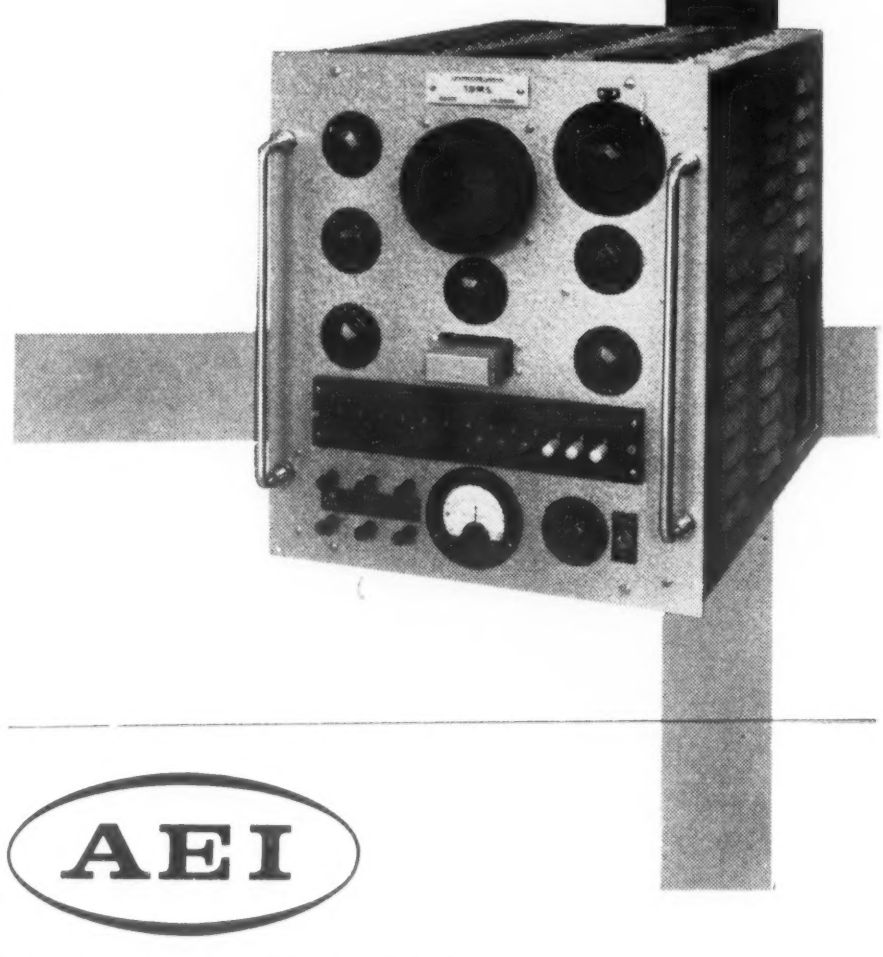
Telegraph distortion measurement

in the speed range 40-400 bauds

Rapidly increasing international use of high-speed synchronous telegraph systems has led to the urgent need for suitable distortion measuring equipment. M.S. Type TCA1219, manufactured by A.E.I. at their Woolwich factory to a British Post Office design, enables distortion measurements to be made within 1% accuracy. The method of indication is by bright spots on the circular time base of a cathode-ray tube. Screening and the fitting of radio interference suppressors have been given particular attention.

Size	17 in. high x 15 in. wide x 18 in. deep
Weight	110 lb.
Power supply	200/250 v. 50 c.p.s.
Power consumption	170 w.

1:1
2:2
6:1
7:7
Q9S
or any single character



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U.S. Army Supply Operations

(*Continued from page* 44)

The Army system has had four emergencies since World War II. The first was Korea, which indirectly was responsible for the reorganization of the supply depot complex of the Communications Zone. This emergency was handled poorly.

Next was the crisis in Hungary with various mobilizations of troops and combat preparations. This was handled better. Then came the Suez incident, and finally, Lebanon. Lebanon proved the value of the system.

Consider the problems. All the supplies needed had to be assembled quickly for air transportation. Food, medicines and medical equipment, tents and uniforms, cooking and refrigeration facilities, trucks, and earth-moving equipment, all to deal with the terrain and the hot arid climate of Lebanon. Everything had to be brought in from the outside. The telephone and radio communication system, and control machinery, and all the electronic equipment associated with the modern Army had to come in a large part from the depots.

The Lebanon Landing

The Lebanon landing may very well go down in history as one of the finest operations ever carried out by the military forces of the United States, and perhaps the finest and most unique operation of its kind in the history of the world to date.

This operation, contrary to the fears when it began, not only proved successful in straightening out an explosive situation in the Middle East, but added enormously to the prestige of the United States, and the good will of all the poeple in the Middle East who were affected. The forces landed without casualties, maintained their positions without incident, lived off their own supplies and used their own equipment, so there was no dislocation of the economy of Lebanon, and no incidents between the military and the native population. It could not have succeeded without supply depots of great efficiency.

One of the encouraging features of the Supply Depots at Poitiers is the high morale, and the dedication of the personnel to the job at hand. A supply depot is not as glamorous as a fighting command. Preserving, maintaining, guarding, receiving, and shipping of supplies requires constant and meticulous attention and long hours. Brigadier General Richard J. Meyer, Commanding General of the Depots, and his Staff, Colonel Geoffrey D. Ellerson, Deputy Commander, and Colonel Robert W. Grote, Chief of Staff, are to be commended for the efficiency and high morale.

I should also like to congratulate Colonel Carl W. Kohle at Ingrandes; Colonel Galanti at Chinon; and Colonel Paul A. Feyereisen at Saumur, Commanding Officers of the three Depots.

Whereas housing for the depots is adequate, housing for the officer personnel is not. Over seventy per cent must pay relatively high rents in the surrounding towns. The recreation facilities are by no means as comfortable or as adequate as those in other European military installations, notably Germany.

The relations of the command with the French people are good. Over two-thirds of the labor functions are performed by civilian personnel who work extremely well despite the fact that the American forces pay less wages than the surrounding industry. In order not to disturb the economy, the French government prescribes the wages that can be paid.

The first golf course in the area was built by the Army. Although it has only nine holes, and is not up to championship specifications, it has provided a great deal of pleasure to both officers and enlisted men. I hope that it will be improved, and that more courses will be built. The cost is negligible since the construction work is principally earth-moving, a basic element in the training of enlisted men in construction activities.

The French people have been permitted to join the golf club, and its operation may well prove of considerable benefit to Franco-American relations.

It would be very helpful if more Americans could see and learn of some of the things our modern Army does to maintain its efficiency and to save money. I consider the Army supply system equal to the best operations of private industry.

I also wish more people would understand the importance of the Army aside from its requirement to preserve our freedom. The Army is the only disciplined force that would be available on land in time of national disaster. Should there be an attack on this country, the principal source for food, clothing, and shelter would be the Army. It is important to realize that only the Army supply groups have the means to furnish reasonable amounts of food, equipment and supplies to get us over the destruction of an atomic blast.

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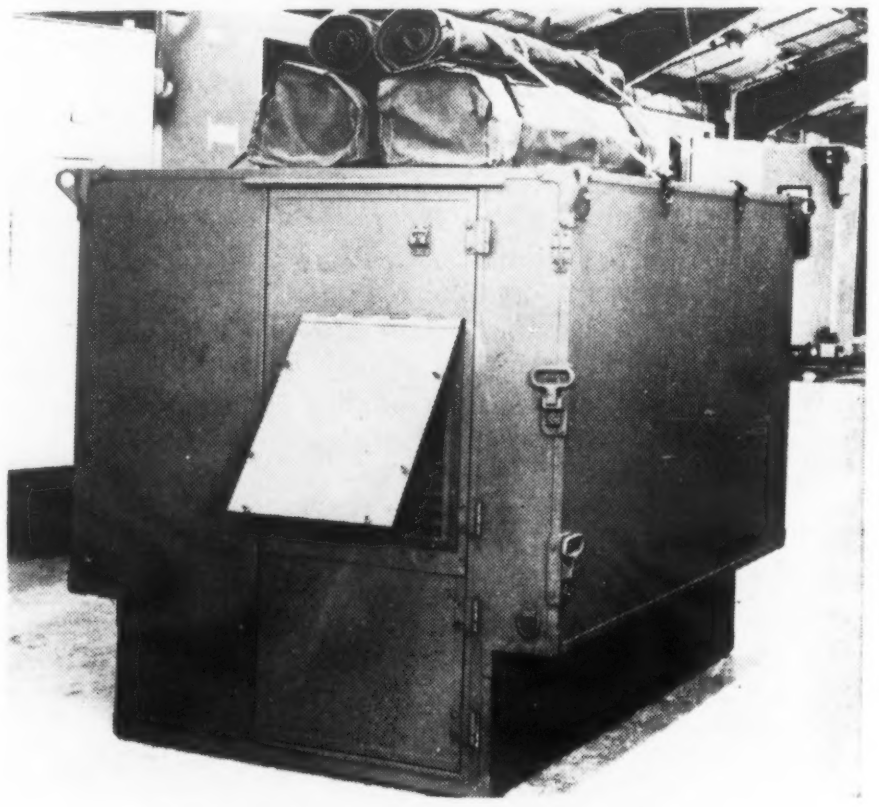
PORTABLE MILITARY SHELTERS BONDED WITH EPOXY ADHESIVE

by Neil Kvasnak
Vice President,
Craig Systems, Inc.



Electrical equipment shelter is completely equipped for area type communication systems. Lightweight shelter has up to 15 to 1 payload/weight ratio.

THE NEW ARMY concept, the recasting of the division's triangular 3-regiment structure into a smaller pentagonal form of 5 battle groups, was designed around greater fire power and reduced manpower. This "Pentomic Army" consists of trained mobile task forces capable of semi-independent operation with considerable distances between them to reduce vulnerability to atomic weapons.

To meet these demands for optimum maneuverability, communication systems had to be redesigned for wide ranging mobility in order to increase a commander's ability to control a battle.

Communication centers and subcenters had to be readily transportable by ground and/or air for quick service as soon as positioned. This was accomplished by means of lightweight, sturdy, air transportable shelters and vans for the housing and protection of electronics systems during operation, transit and storage.

Such shelters have been pioneered by Craig Systems, Inc., and the newest of them incorporate design features which effectively reduce weight, yet provide load-carrying characteristics with as high as a 15 to 1 payload/weight ratio. Called "Helicop-Huts," the enclosures are designed to integrate and protect highly sensitive and complicated equipment from shock impact, vibration, humidity and other service conditions. They can be transported by sling from a helicopter without any deformation to the enclosure or can be loaded inside a C-119 or larger cargo aircraft. In other cases they can be towed by standard field-type military vehicles when mounted on a quickly attachable dolly.

Until about 10 years ago most mobile shelters employed conventional construction; i.e., structural frame work, an outer metallic skin, usually glass fiber insulation, and an inner skin of plywood or pressed board. In the main, all of these shelters were quite cumbersome and not at all suitable for transport by air. The earliest models of bolted construction proved undesirable for mobile military use since the bolts always required clearance holes. Under stress of field use the bolts would work loose and water would leak into the shelter with subsequent damage to installed equipment. A later switch to riveted and welded construction also proved impractical because shelters made in this manner were still too heavy for rapid transportation.

Because of the need for a shelter with the highest possible payload to basic structure weight ratio, these and other methods and materials were discarded in favor of a completely new approach to military shelter design. The new techniques evolved over the past few years into a sandwich-type of construction which ultimately met all of the requirements for a thoroughly serviceable and mobile shelter—it weighed about two-thirds less than comparable previous units, was capable of holding tremendous equipment loads and it could be picked up and moved easily. These enclosures are now built to military specification in sizes from 4¾′ x 5′ x 6′ up to 6⅓′ x 6⅓′ x 14′, and have an assured service life of five years.

Basic design of the new shelters consists of two high strength, heat treated aluminum skins which are bonded to extruded aluminum framing members with an epoxy resin adhesive. Space between inner and outer skins is filled with a foamed-in-place isocyanate core.

One of the prime reasons for the selection of adhesive bonding, apart from its inherent toughness and resistance to chemicals and weathering, was that for the first time shelters could be built with the high temper aluminum alloy, 6061-T6. This thin, high strength aluminum could not be used on previous shelters because welding heat inevitably annealed the metal. Epoxy adhesives can be cured at room temperature or low heat and therefore do not affect the temper of the aluminum. Tensile shear tests (in accordance with MIL-A-5090A) demonstrated shear strength at least 80 per cent greater than specified.

This adhesive is based on Epon* resins and is produced by Lawrence Adhesive & Chemical Company, Lawrence, Massachusetts, one of the suppliers of epoxy compounds to Craig Systems. The adhesive is a thixotropic (non-sagging) metal-to-metal bonding agent supplied as a

*Reg. Trade Mark, Shell Chemical Company.

two-component system of resin and curing agent.

Framing members for floor, roof and wall of the shelters are angular aluminum extrusions. Where specified, vertical mounting ribs and other extruded members are inserted between the wall skins to serve as anchoring mediums for the fastening of electronic and other equipment. All of the individual frames and ribs are bonded together with the epoxy adhesive. The aluminum skins are then inserted into the extrusions and are likewise bonded; once the adhesive has cured, the bond between extrusions and panels is virtually indestructible.

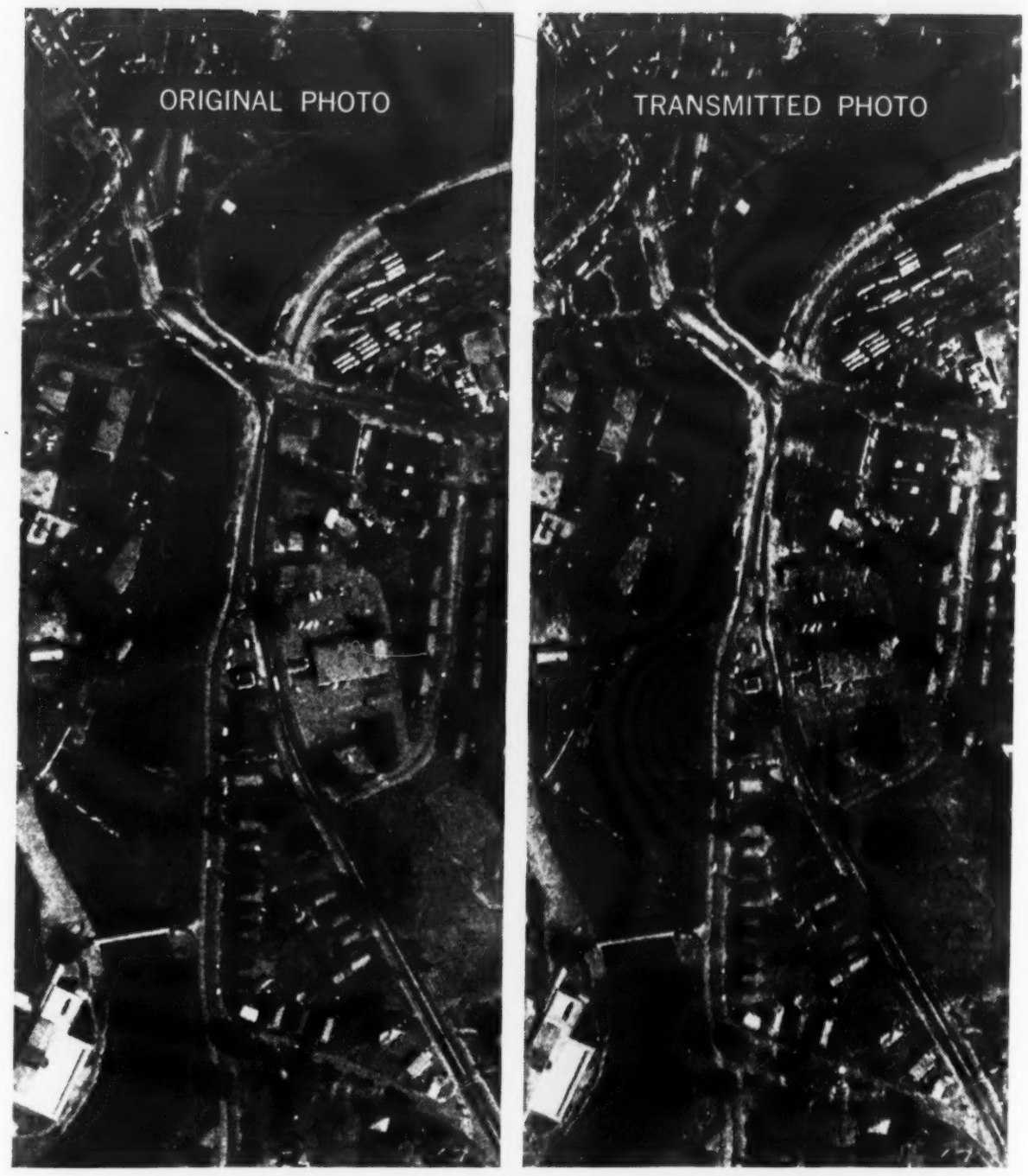
After the panels have been assembled, they are filled with the isocyanate foam which is capable of transferring some shear between inner and outer skins by distribution of shear loading. The foam also imparts tensile, shear and compression loading to the vertical members embedded within the core material. In addition to supplying strength and rigidity to the panels, the foam is also an excellent insulation medium and is fire-resistant.

The completed floor, roof and wall panels are then bonded together to form the enclosure. For additional weather protection, all exterior seams and joints are filleted with the adhesive.

The ruggedness of the foamed-in-place panels and bonded aluminum construction is graphically illustrated by the grueling battery of tests which the shelters have passed successfully.

The S-144 shelter, weighing only 350 pounds, was loaded with 1500 pounds of simulated electronic equipment. It was dropped ten times from heights ranging from 1 ft. up to 8 ft. without damage. In actual helicopter transport flat drops up to 2 ft. were made without deforming the shelter or damaging the equipment, and it was lifted easily from a site on uneven terrain where there was a compound slope having at least a 10 degree slope in both directions.

Equally successful were Helicop-Hut tests for insulation (a 2 in. thick panel has a coefficient of heat transfer of 0.115 btu/°F/HR/Sq. Ft.); air tightness; snow load (75 lbs./sq. ft.); temperature range (—80F to 160F); humidity (five 24-hour humidity cycles without damage); fording (floating free in water loaded with 7000 pounds of simulated equipment); rain; and salt spray (50 hours).



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Challenging career opportunities are available at CBS LABORATORIES on long-range systems development programs such as PHOTOSCAN. Positions for physicists and electrical engineers are now open in the following department: Military and Industrial Systems; Acoustics and Magnetics; Solid State Physics; and Vacuum Tube Physics.

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GENERAL SYSTEM

by Lt. Col. C. V. Glines, USAF

STUMPY JOHN SILVER

world's most famous war pigeon

ONE OF THE most famous World War I Army veterans died over 24 years ago. But his body has been preserved and thousands of visitors come to see his battle-scarred remains each year.

His name: "Stumpy" John (nmi) Silver and he can be seen at the Air Force Museum located at Wright-Patterson Air Force Base near Dayton, Ohio.

Stumpy is a Signal Corps homing pigeon who, before the days of walkie-talkie radios and teletype machines, made himself as well-known as General John J. Pershing or Captain Eddie Rickenbacker.

Born in a dugout just behind the lines in France in January, 1916, Stumpy got his basic training flying routine messages between the front and the headquarters in the rear. As soon as he was fully grown, he was assigned the job of carrying messages between patrols deep in enemy territory and his divisional headquarters.

It was during the Meuse-Argonne offensive that Stumpy earned his reputation as a "barrage dodger." He was able to pick his way around and through the heaviest shellings, seemingly guided by a sixth sense. Day after day he made his daring flights and always managed to come through even though many of his pigeon buddies were killed or wounded.

Then, on October 21, 1918, in the midst of heavy fighting at Grand Pre, Stumpy took off with a vital message for his division headquarters at Rampont, 25 miles away. The bombardment was the most intense of the war, yet Stumpy was able to pick his way between the shell bursts as gracefully as a dancer.

Suddenly, men in the trenches saw a shell explode near him. Its concussion threw him straight up in the air for a hundred feet amid a shower of feathers. But instead of falling to the ground, Stumpy flapped his wings wildly and managed to stay aloft somehow. He kept on.

Twenty-five minutes later, Stumpy flopped into his roost at Rampont. A machine gun bullet had pierced his chest, bits of shrapnel had ripped his body and his right leg was missing. The message tube, however, was still dangling from the ligaments of his shattered leg.

The men of Stumpy's division nursed him back to health. The stump of his right leg healed and he could still fly. His spirit and gallantry endeared him to the men and they gave him the official name "Stumpy" John Silver, after the name of the one-legged pirate in "Treasure Island."

When the Armistice came and the troops were mustered out, Stumpy stayed on in France until 1921 when he was retired from active service. He was assigned to the 11th Signal Company, U. S. Signal Corps, Schofield Barracks, Hawaii and stayed there until he died on December 6, 1935 at the grand old age of 17 years and 11 months—one of the world's oldest pigeons.

The 11th Signal Company will never forget Stumpy John Silver. On each Organization Day of the Company, the name of "Silver, Stumpy John" is called out at roll call. The senior non-commissioned officer present answers:

"Died of wounds received in battle in the service of his country."

Today, Stumpy John stands proud and erect in his glass-enclosed pedestal. Over 350,000 people a year come to see him and marvel at his record. Who can deny that his gallantry and courage deserve a permanent place in the pages of American military history.

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The President, the immediate Past President, the Vice Presidents and the Counsel are ex-officio members of the Board of Directors.
******Executive Committee Member.*

Association affairs

Col. John Morrison, (left) and Col. Joseph Plihal, (right) look on as The Earl Mountbatten of Burma, (2nd from left) receives an honorary AFCEA membership certificate from Maj. Gen. Harold W. Grant. The certificate was presented in London last month.

Honorary Member

The Earl Mountbatten of Burma, Chief of Britain's Defense Staff, was presented with an inscribed certificate of honorary membership in AFCEA last month. Major General Harold W. Grant, USAF, Director of Communications-Electronics and a vice president of AFCEA, presented Lord Mountbatten with the certificate in a short ceremony at the Ministry of Defense in London. He was accompanied by Colonel John E. Morrison, Deputy Chief of the Policy Group of the Communications-Electronics Directorate at USAF Headquarters and Colonel Joseph A. Plihal, president of the London chapter of AFCEA and Director of Communications-Electronics, Third Air Force.

The award of honorary membership was made to Lord Mountbatten in recognition of his long standing personal interest in defense communications. Early in World War II, as Chief of Combined Operations, Lord Mountbatten was the principal architect of communications plans so vital to the success of Operations. The effectiveness with which these operations were conducted was due in large measure to Lord Mountbatten's concept of a "Headquarters Ship," a floating command post which functioned as the communications hub for the command and direction of the participating forces. Later in World War II, as Supreme Allied Commander, Southeast Asia, Lord Mountbatten contributed still other communications concepts which aided greatly in the task of coordinating the operation of military forces deployed over a vast area.

Lord Mountbatten is the second Briton and the third non-American to receive honorary membership in AFCEA.

Ham Activities

Amateur radio enthusiasts are being invited to join AFCEA, take part in the Association's ham activities and be listed in the AFCEA amateur directory. At the request of Ray Meyers, W6MLZ, Region F Vice President, special membership invitations are being sent to individuals interested in amateur radio.

Presently Ray Meyers is in the prosess of revising the amateur directory which lists AFCEA members by their call letters and their geographic locations. Containing the names of approximately 400 AFCEA ham operators, the directory first was issued in March 1959. AFCEA ham operators not previously listed in the directory should send their names and call letters to Ray Meyers so this information can be included in the new directory.

Republic Aviation Corp.

Republic Aviation Corporation is a new group member of AFCEA. Republic Aviation does work in such fields as hydromagnetics, hypersonics and plasma physics. A $14 million Research and Development Center, recently completed, will expand studies in space exploration and upper atmosphere flight.

Representatives for Republic Aviation are M. Minneman, Scientific Research; H. Belderok, B. Wanty and W. Shanney, Production Engineering; Hans Wolff and G. Abaid, Applied Research & Development; P. Brice, W. Derganc, J. Torian and S. Treman, Missile Systems Division.

Chapter at Okinawa

A new chapter at Kadena Air Force Base, Okinawa held its organizational meeting May 2. Col. Edward C. Coffin, Jr., USA, was elected president and Lt. Col. Russell H. Marks, USAF, was chosen first vice president. Other officers are Lt. Col. James W. Tuma, USMC, second vice president; Ralph E. Witsiepe, Philco Corp., secretary and C. W. Axsom, DAC, treasurer.

Upon approval of the chapter's constitution by National Headquarters, plans will be made for the first general meeting at which the charter will be presented to the chapter.

The fifty-first chapter to become affiliated with AFCEA, the Okinawa chapter has 45 members on its roster.

Films for Chapter Meetings

Several motion picture films on electronics can be obtained by AFCEA chapters for use at chapter meetings.

Hughes Aircraft Company, Culver City, California has recently made motion picture films available based on developments in the manufacturing of advanced electronic equipment and nuclear and space programs. Many of these films have been shown by California groups and have been found to be an excellent vehicle for orientation in certain phases of the electronics field. Among the fourteen films made available are: *The New Giant*, a 16mm, color, 15 minute film which examines the tremendous growth of the military electronics industry and emphasizes the vital role played by highly skilled human beings in the creation of airborne automation (The film was a business/industrial award winner at the 1958 Columbus Film Festival). *Electronics for the All-Weather Interceptor*, a 16mm color, 22 minute film which presents a resume of aerial weapons from World War I through today's complicated interceptors with their thousands of electronic components; and, three 26 minute, color films which were shown in the Science in Action television programs produced by the California Academy of Sciences. These three films cover miniaturization, infrared research and the history and development of radar. To obtain a complete catalog of films available and for further information, contact D. R. Knickerbocker, Public Relations, Hughes Aircraft Co., Culver City, Calif.

Trapping of Free Radicals at Low Temperatures, is a 16mm color film which presents a study of free radicals. Free radicals take part in almost every chemical reaction and are especially important in high-temperature reactions such as rocket flames and stellar atmospheres. The films are available for loan or sale from the Office of Technical Information, National Bureau of Standards, Washington 25, D. C.

Paul H. Clark, regional vice president, presents the Cincinnati charter to R. G. Edwards, chapter president. The presentation was made at the chapter's first meeting in April. (See Chapter News for other photo and full details.)

Melpar, Inc.

Melpar, Inc. has become a group member of AFCEA. Located in Falls Church, Virginia, the company currently is working on 120 advanced defense and space exploration projects. Work is done in such areas as reconnaissance systems, ground data equipment and communication and navigation systems.

Those named as representatives are: Thomas Meloy, Arthur C. Weld, Charles B. Raybuck, J. P. Chambers, Ralph I. Cole, Capt. E. H. Pierce (Ret), Capt. James A. Morrison (Ret), E. L. Becker, S. M. Benford and R. C. Davis.

Ryan Aeronautical Co.

Ryan Aeronautical Company of San Diego, Cal. is a new group member. The company has named the following as AFCEA representatives: E. G. Uhl, Vice President, Technical Administration; P. C. Hickerson, Director, Customer Relations; C. A. Cordner, Special Project Engineer; J. W. Short, Unit Chief Systems Development; J. R. Giantvalley, Design specialist; O. S. Olds, Director, Engineer and Customer Relations; O. P. Gottwald, Chief Engineer; L. R. Everingham, Director; H. M. Watts, Associate Manager and Technical Director, and J. Kravatz, Director Government Relations.

Personnel & Positions Available

As a service to AFCEA members, SIGNAL will make space available in this column for those members who are interested in employment in the communications, electronics and photography industries. Any member is entitled to three insertions in the magazine on a space available basis, free of charge. Please limit your notice to 5 lines. In replying employers are asked to address: Box ——— SIGNAL, 1624 Eye St., N.W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

ELECTRICAL ENGINEER with 9 years' experience in all phases of telephone utility operation-engineering, accounting, traffic and management. B.S. in electrical engineering and business administration. Salary and location open. Box 155.

FIELD SERVICE ENGINEER with six years' experience seeks position in Japan. Speaks the language and is familiar with travel in Japan. Knows aircraft, ground communications and navigational systems. Box 156.

CUSTOMER ENGINEERING position sought by individual with eight years' experience as a Teletype repairman. Attended radio repair school for two years and was a CREI home student for the past three years. Located in Tokyo. Box 157.

COMMUNICATIONS ENGINEER with twelve years' knowledge of Japanese governmental and industrial communications desires position in Japan. Fluent Japanese, MS Business Administration. Capable sales and engineering-administrative management. Box 158.

TELECOMMUNICATIONS ENGINEER 1 years' experience in microwaves, tropo scatter, VHF radio, electric utilitie communications systems. Seeks pos tion similar fields or sales with manu facturer, consulting engineer or privat system. Box 159.

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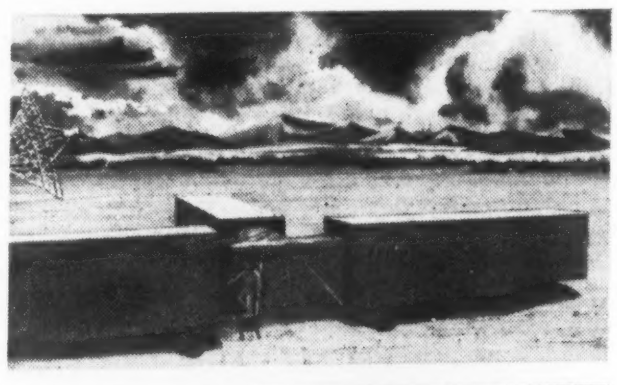
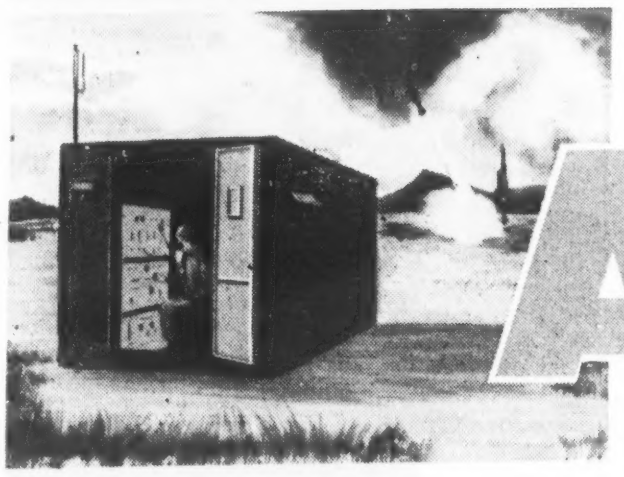
THE BIG A LEADS THE WAY TO *INTEGRATED* COMMUNICATIONS SYSTEMS

SATELLITE RELAY SYSTEM A reliable, worldwide network for television, facsimile, telephony and telegraphy communications will be realized in the near future through PROJECT COURIER of the Advanced Research Projects Agency and U.S. Army Research & Development Laboratories. As subcontractor to I.T.&T., Adler is responsible for engineering and manufacture of the ground stations of this earth-satellite relay. Each of these air-ground transportable stations can duplex transmit, receive and store 15 million bits of information in the 4-minute-contact with the satellite. The COURIER's pre-launching checkout system, also, was produced by Adler.

TRANSPORTABLE TROPOSPHERIC SCATTER SYSTEM A new concept in continent-spanning tropospheric scatter communications soon will be available to the U. S. Air Force. For the first time, the full multichannel capability and reliability of a large, fixed installation will be provided in a compact, air-ground transportable package. The all-environment, 10KW, AN/MRC-85 is being designed, system integrated and manufactured by Adler under subcontract to Page Communications.



SPECTRUM-STRETCHING COMMUNICATIONS SYSTEM Through Adler pioneering in heterodyne repeating, a wide range of UHF channels have been opened to the U. S. Army for NIKE Missile field communications. The Adler "F-Head" unit permits the basic AN/TRC-24 VHF system to be used for UHF relaying in areas where VHF spectrum congestion is a problem. Designed for plug-in use, the "F-Head" heterodynes the VHF output of the AN/TRC-24 to the usable UHF range. Adler heterodyne techniques are finding an ever-growing place in military, industrial and commercial communications.



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ADLER

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NEW MEMBERS

Listed below are new members of the AFCEA who have joined the Association during the month of April. Members are listed under the chapter with which they are affiliated.

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R. E. Utman
J. Paul Jones

Atlanta

Hubert F. Lee
Tom R. Kelley
Richard G. Henley
Douglas A. Bryan
Ernest B. Holditch
Raymond W. Hicks
Marvin T. Largin
John W. King, Jr.
Harold C. Barfield
James D. Walker
Charles Morgan, Jr.
William H. Young
Jack W. Yarbrough
Arthur F. Potter
John C. Knupp
Paul R. Caldwell
Erby M. Mink
Ralph A. Barker
Lt. Col. Coleman E. Alford
Ronald R. Spencer
James A. Leggett
R. M. Deshon

Augusta-Ft. Gordon

Richard F. Murray
Lt. Col. Simon A. Stricklen
1st Sgt. Roger L. Reid
Maj. Thomas E. Chandler
Richard M. Walsh
Underwood Spivey
2nd Lt. James D. McGowan
2nd Lt. George H. Calhoun
Sgt. Joseph P. Sosna
SFC Maynard K. Piper
M-Sgt. Thomas G. Phillips
SFC Paul C. Bennett
M-Sgt. John Canning
Sgt. E-5 David W. Buckner
SP-5 William Sipe
SFC-E-7 James F. Anderson
M-Sgt. Jack E. Stallard
M-Sgt. Earl O. McCormick
1st Sgt. Thomas A. Timmons
SP-5 Charles F. Clements, Jr.
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As part of a major study of space communications techniques, Philco is prime contractor for an Air Force project to relay high frequency radio communications around the curvature of the earth, through space. Known as the Passive Satellite Relay Link, it will reflect voice and teletype signals from a 100 ft. aluminum-skinned plastic balloon. Under NASA's Project Echo, the balloon is to be launched into a 1,000 mile earth orbit for use as a passive communications reflector.

The parametric amplifiers, receiving antennas, and tracking and receiving systems are Philco designed, built and installed. The entire program is managed by Philco, under the supervision of the Communications Directorate, Rome Air Development Center.

This is one more step in man's utilization of outer space . . . and another important Philco achievement in global communications. For capacity, facilities and experience in advanced electronic systems, look to the leader . . . look to Philco.

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Chapter News

Atlanta

A record attendance of 307 members and guests were present at the March 22 meeting to greet and hear our national president, Benjamin H. Oliver, Jr. The dinner meeting was held at the Fort McPherson Officers' Club with A. E. Arnold, president of the chapter, presiding.

Mr. Oliver chose as his subject, "The Place of AFCEA in Communications." He paid a glowing tribute to Kelly Mosley, Regional Vice President, for the fine job he is doing for AFCEA in this region. He then told the interesting story of AFCEA—how it was started by General Hal Ingles, who at the end of World War II realized the value of the liaison built up between the Army and civilian communications personnel. To preserve this he established the Army Signal Association. Soon, because other branches of the military service participated, the name was changed to Armed Forces Communications Association. It was later changed to its present name when electronics became an important factor in signal work.

AFCEA now has about fifty chapters, Mr. Oliver stated, eight of which are in foreign lands. He told about the efficient organization at national headquarters and of the approaching convention, and closed his address by emphasizing the importance of the local chapters. "The national organization derives its strength from the local chapters and can be only as strong as the chapters," he said.

At the conclusion of his talk, Mr. Oliver received a standing ovation from the large group present.

Augusta-Fort Gordon

Members of the chapter welcomed the new commanding general of the Army Signal Training Center at Fort Gordon to their March meeting and announced plans for a third annual high school science scholarship.

Lt. Col. Fred J. Frank, chief of the Signal Integrated Training Facility at the Signal Center and president of the chapter, welcomed Brig. Gen. Benjamin H. Pochyla on behalf of the members.

The scholarship, part of the national AFCEA program to sponsor science education is expected to exceed $500. It will be awarded to a high school senior from the Augusta area and will be applied to the college of his choice as part of first-year tuition.

Winners will be announced, following a screening by members of the AFCEA awards committee in conjunction with principals of various high schools.

Lt. Col. Fred J. Frank, SigC, president of the chapter, has initiated a membership drive. The individual bringing in the most members each month is being awarded a bronze membership button.

Chicago

A talk on "Defense Against Ballistic Missiles" and presentation of Technical Association awards were the featured highlights of the chapter's March 31 meeting at Western Electric Co.

J. W. Schaefer, military development engineer of Bell Telephone Laboratories, was the guest speaker. He presented the philosophy, history and development of the U.S. missile air defense program, which is now unclassified. Host for the evening was Fred B. Smith, works manager of Western Electric's Hawthorne plant.

Four members of the U.S. Army Reserve in Illinois received honor awards for their outstanding performance and accomplishment in the field of communications and signal activities. William L. McGuire, chapter president presented certificates to: MSgt. David L. Betteridge, 301st Signal Co. (Base Maintenance); MSgt. David Johnson, Jr., Co. C, 306th Signal Bn; SFC Harold J. Kehl, 75th Signal Bn; and S/Sgt. Joseph T. Mendoza, Hq and Hq Co., 306th Signal Bn. SFC Henry T. Burzych, Co. A, 133rd Signal Bn. Illinois National Guard also was selected to receive the award.

Prior to the dinner-meeting, members and guests were taken on a tour of Hawthorne's rod and wire mill and cable plant.

Cincinnati

Local representatives of the Armed Forces and leading communications, photographic and electronic firms attended the chapter's first meeting which was held April 26, at the Cincinnati Club.

Paul H. Clark, AFCEA Regional Vice President, presented the chapter charter to R. G. Edwards, chapter president. Other officers are J. D. Stuart, first vice president; Capt. Ralph T. Quick, second vice president; Henry Lemeur, secretary and A. L. St. Cyr, treasurer.

Those attending the meeting were R. G. Edwards, F. C. Gilmer, Jim Horney, C. R. Keller, J. P. Meehan, R. M. Ormiston, O. E. Pienkowski, Dick Pitts, J. O. Rhodes, C. W. Schleicher, Chuck Stohl, and Jack Ward of American Telephone & Telegraph Co.; George Geick, Bill Harter, Henry Lemeur and Frank Wissell of Avco; John Bruning of Baldwin Piano; M. M. Wehner of Bendix Corporation; Earl Hilburn of Burton Rogers; G. J. Buchanan, H. D. Hankins, Ed Kinney, F. G. Sanning and W. J. Studt of Cincinnati & Suburban Bell Telephone Company; Bob Dronberger of Eastman Kodak; Fritz Mezher of General Electric; E. A. Bolger and R. O. Godmere of Haloid Xerox; Jack Stuart of International Business Machines Corporation; Roland Davis of Ohio Appliances; Alain St. Cyr and I. L. Templer of Western Union; Paul Clark of Radio Corporation of America and Capt. Woodrow Cooke and Capt. Roderick Stewart.

Decatur

The chapter held its April meeting at the Decatur Signal Depot Officers' Mess on April 26. Mr. Roy Johnson of Pfiles Camera Shop was guest speaker. He discussed and exhibited the latest in photographic equipment.

Fort Monmouth

The election of officers took place at the meeting on April 21. The following will administer the activities of the chapter for the coming year: President, Dr. Hans K. Ziegler; 1st Vice President, Colonel Murray Little; 2nd Vice President, Mr. Charles Marsh, 3rd Vice President, Mr. Harry C. Ross; 4th Vice President, Mr. Paul Welch; Secretary, Mr. M. Werksman; Treasurer, Mr. T. Schlitz.

Members of the Board will be Maj. Gen. William D. Hamlin, Brig. Gen. Charles M. Baer, Colonel Harold McD. Brown, Colonel H. E. Price, Colonel R. F. Wilson, Colonel M. R. Kunitz, Colonel J. L. Wilson, Jr., Brig. Gen. J. R. Heinrich, Mr. John Wyman, Mr. Robert Boden, Mr. J. H. Worth, Mr. Ray Gilbarte, Mr. Charles Arthur, Mr. Norman Freeman, Mr. Willie Doxie, Mr. John Weseloh, Mr. Feleix Celli, Major Charles R. Rambo, Mr. A. J. Dalton and Mr. J. P. Hoffman.

Gulf Coast

The ninth anniversary of the chapter was celebrated at the April dinner meeting. Among the organizations represented were Keesler Electronics School, the Biloxi Amateur Radio Club, the Naval Reserve Unit of Pascagoula, Miss., and the Louisiana Chapter.

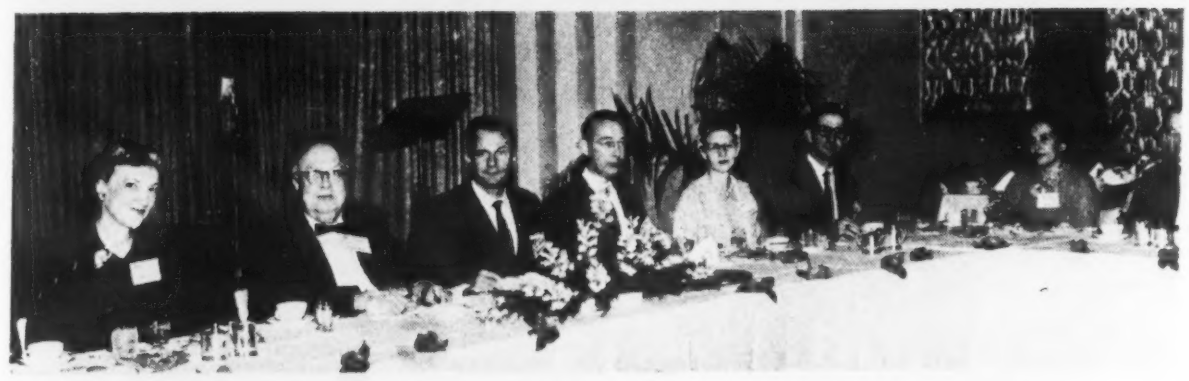
Mr. Ancil Arseneau, a former president of the chapter, after giving a concise history of the chapter, introduced the principal speaker, Dr. Joseph C. Morris, Vice President of Tulane University. Dr. Morris presented a most interesting talk on "Man In Space," during which he showed a film describing the effects of gravity on man when he makes a trip into outer space.

(*Continued on page 73*)

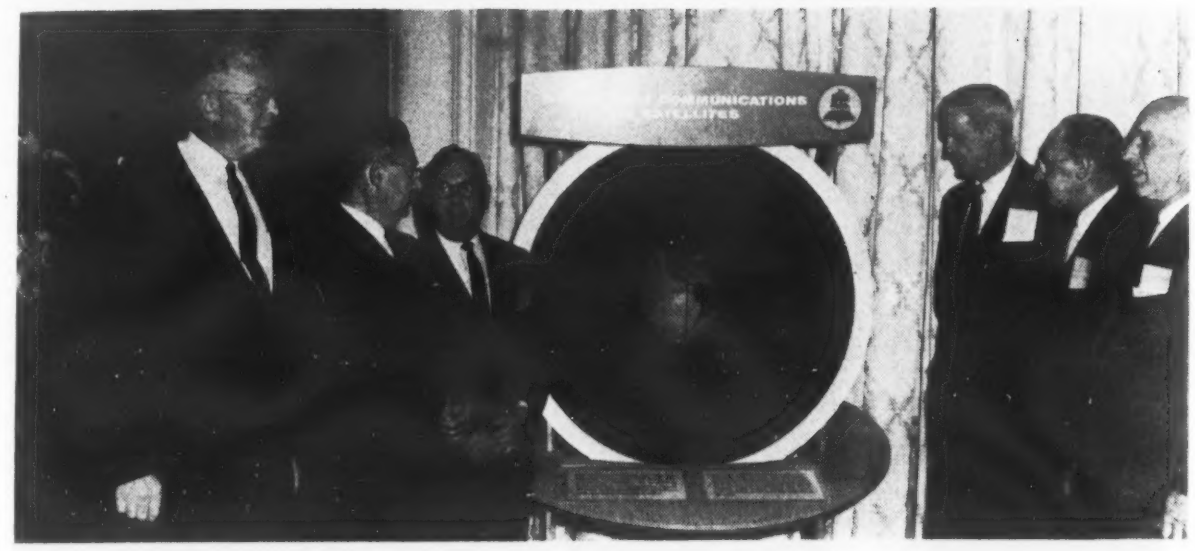
Atlanta — Shown at the chapter's March meeting are, seated from L to R: Lt. Col. T. A. Pugh; Louise Foster; Ruth Lawson; Bobby McMahan; Dot Hunter; Benjamin H. Oliver Jr., National President of AFCEA; Evelyn Ray; Kay Harris; Mary King; and Henry McKinley. Standing from L to R are: E. Crutchfield; A. Cartey; Lt. Col. L. J. Ross; W. Mollands; W. Burnett; J. Seigle; Peggy White; A. Arnold; A. Wilson; Jane Radford; W. Kelly Mosley; J. Ramsey; G. Mulliniks and G. Sweeney.

Cincinnati—Officers of AFCEA's 50th chapter are from L to R: Alain St. Cyr, treasurer; Henry Lemeur, secretary; Jack Stuart, 1st vice-pres. and Ralph Edwards, chapter president. 2nd vice-pres., Capt. Ralph Quick USMC was not present for the picture.

Ft. Monmouth — Dr. Hans K. Ziegler, (right) Chief Scientist, U. S. Army Signal R & D Laboratory, is the new chapter president. With Dr. Ziegler are Maj. Gen. Wm. Hamlin, Post Commander (center) and Norman Freeman of Stromberg Carlson Div., General Dynamics Corp., the outgoing chapter president.



Gulf Coast—Shown at the chapter's 9th Anniversary meeting from L to R: Maj. A. L. Briggs, publicity; Dr. Joseph Morris, Guest Speaker, Vice Pres. of Tulane University; Lt. Col. George Walborn, president; Ancil Arseneau, Program Committee; Mrs. Malone; SMSgt. Malone, vice-pres.; Mrs. Kelly and Pete Kelly, secretary.



New York—Henry Bang, chapter president welcomes Western Electric Co. dignitaries at pre-meeting briefing by Guest Speaker, Rod Goetchius. From L to R are: H. Bang; C. R. Smith, Vice Pres., Radio Div.; W. E. Burke Vice Pres., Defense Projects Div.; J. A. Bowman, Project Manager, Distant Communications and Warning; E. W. Baker, Project Manager, ADES and Rod Goetchius Manager Project Mercury. The display in background is of The Bell Laboratories Project Mercury, World-Wide Systems display.

Paris—At right is a scene from the chapter's spring dinner held at the Cercle National des Armees. Over a hundred members and guests attended the event.

Rome-Utica—Pictured at a recent meeting of the chapter are from L to R: Benjamin H. Oliver, Jr., National President of AFCEA; Murray Socolof, president of the chapter; Brig. Gen. Haskell E. Neal, Commander, Ground Electronics Engineering-Installation Agency; Lt. Col. Michael Bobela, HQ, Ground Electronics Engineering-Installation Agency; Beverly Gallup, Motorola Inc.; and Allan Kunze, Rome Air Dev. Center.

Scott-St. Louis—Seated from L to R are new chapter officers: K. Norris, treasurer; Col. C. Evans, USA (Ret.), vice-pres.; Col. David Baugher, president; Lt. Col. M. Kovar, USAF, vice pres.; and A. Eisenmayer, secretary. Standing from L to R are new directors: B. Robards; H. Cooper; A. Lenny; E. Hagen; L. Dechant; RAdm. R. Melling, USN (Ret.); L. Miller; and Col. G. Zahn, USAF. New directors, Maj. Gen. Doubleday, USAF and H. Vermillion are not pictured.

Southern California—Shown at right are chapter members and guests attending the March dinner meeting. Guest speaker at the event was Col. Harry L. Evans, Assistant Deputy Commander for Military Space Systems at the Air Force Ballistic Missile Division.

Tokyo—Shown presenting the Toyko AFCEA industrial award to Yoshinobu Kagawa of the Sony Corporation is Colonel B. H. Wells. The award was accepted at a chapter meeting by Mr. Kagawa for Dr. Leona Esaki who was on a business trip to the U. S.

London

The meeting on March 31 was attended by 102 members and guests. After loyalty toasts were made to the Queen and the President, a very interesting presentation was made on the Ballistic Missile Early Warning Program. The talk was presented by Lt. Colonel E. Halliwell and Major C. A. King, London Liaison Officers for the BMEWS Project.

New York

Mr. R. M. Goetchius, Defense Project Manager, Western Electric Company, was guest speaker at the meeting on April 27.

He discussed the National Aeronautics and Space Administration and the Mercury project, highlighting Western Electric's efforts in constructing an 18-station tracking and communication network. He showed slides of some of the installations in this network.

Paris

The spring dinner of the chapter was held at the Cercle National des Armées in Paris with over a hundred in attendance. Major General F. W. Moorman, Chief Signal Officer of SHAPE and a life member of AFCEA was elected a vice president of the chapter.

The presentation of the evening was a very informative and interesting talk on the new Ground Surveillance Radar which has been developed for the French Army by Laboratoire Central de Telecommunications with the cooperation of the Mutual Weapons Development Team and the Army Signal Corps. The presentation was under the auspices of General E. Combaux, Chief of all Telecommunications R&D, Production and Procurement for the French Army and included a new color film which was very well received.

In the absence of Admiral Bruton, Brig. Gen. K. F. Zitzman, U.S. Army (Ret), 1st vice president of the chapter paid a brief tribute to the U.S. Army Signal Corps on the occasion of its 100th Anniversary.

Philadelphia

Mr. J. Carlton Ward, Chairman of the Board of Vitro Corporation of America spoke at the April meeting of the chapter. In his talk, entitled "The Impact of Nucleonics and Space on Engineering Technology," he outlined some of the possible situations facing the free world and the challenge they will present to science and industry.

Program Chairman R. M. Fielding introduced Mr. Ward, and chapter president Mr. R. G. Swift introduced the newly elected officers. A cocktail party and dinner preceded Mr. Ward's talk.

Rocky Mountain

The chapter held a luncheon meeting in Colorado Springs on March 29. Honored guests were Walter H. Pagenkopf, Vice President of Region E, and Brig. Gen. D. P. Gibbs, J-6 Headquarters NORAD.

The program consisted of a demonstration of hi-fidelity and stereo by Mr. Al Johnson, House of Sound, Colorado Springs.

Rome-Utica

A photographic process which in a sense fools the human eye into seeing colors which are not present was demonstrated at the April meeting. This process, known as the Land Two-Color Process, was demonstrated and described by Mr. Garth J. Heisig, Director of TV engineering for Motorola Inc. and by Mr. H. Neil Frihart, who is in charge of advanced TV development for the firm.

The presentation involved two black and white transparencies made from negatives of two identical scenes. In one instance a red filter was used on the camera and in the other case, a green filter was used. No color film is involved.

Using two projectors, the two transparencies were super-imposed on a screen. A red filter was placed on the projector containing the transparency made from the negative in which a red filter was used on the camera. No filter was used on the transparency made from the negative in which a green filter was used.

The result of the super-imposition was what appeared to be a full color reproduction, despite the fact that no color film was involved. For comparison, a third projector was used to show the reproduction of the scene as taken with color film.

Mr. Heisig noted that the process has been a much discussed subject by psychologists, physicists and engineers for its potential application to photography, technical displays and color television. He indicated that it was too early to adequately gauge the future of this process on the television industry but it certainly could not be discounted.

Mr. Benjamin H. Oliver, national president of AFCEA, gave a brief talk.

Santa Barbara

The May meeting of the chapter was held jointly with the Military Order of the World Wars and the Retired Professional and Business Men's Club at the Mar Monte Hotel.

Lt. Cdr. Ray E. Meyers, one of the four remaining survivers of the attempt made in 1931 by the submarine Nautilus I to go under the North Polar ice-cap, described this attempt. The talk was followed by a short film of the successful trip under the Pole by Nautilus II.

Scott-St. Louis

A MATS and AACS Briefing highlighted a tour which took place before the April meeting at the Scott AFB Officer's Club. The newly installed RCA computer was demonstrated, as was the AACS Channel and Traffic Control Agency.

The election of officers took place at the meeting, as follows: President, Colonel David W. Baugher, MoANG, St. Louis, Missouri; Vice President, Colonel Charles W. Evans, USA (Ret), S-W Bell Telephone Co.; Vice President, Lt. Colonel Mike M. Kovar, USAF, Hq. MATS, Scott AFB; Secretary, Allan L. Eisenmayer, 1405 AB Wing, MATS, Scott AFB; Treasurer, Kenneth H. Norris, Hq. MATS, Scott AFB. Directors were elected as follows: Harry L. Cooper, AT&T Long Lines, St. Louis; Major General D. C. Doubleday, Commander, AACS, Scott AFB; A. Lisle Lenny, Alton & Southern Railroad, E. St. Louis; Colonel George A. Zahn, USAF, Hq AACS, Scott AFB.

A meeting of the Board of Directors selected Colonel Baugher, President, and Mr. Eisenmayer, Secretary, to represent the chapter at the 1960 AFCEA Convention and on the National Council.

Colonel Zahn introduced the guest speaker, Major General E. Blair Garland, USAF (Ret), Communications Management Department of the Philco Corp. General Garland presented an address entitled "Aircom Modernization Program."

Southern California

The United States space vehicle position was discussed at the March meeting of the chapter. Colonel Harry L. Evans, Assistant Deputy Commander for Military Space Systems at the Air Force Ballistic Missile Division outlined the necessary scope of our space program, and indicated that one or several space weapons was not sufficient to provide positive deterrence.

It will be necessary to develop dependable warning systems to overcome the advantages of the ICBM. In addition, reliable satellite communications facilities must be developed, Colonel Evans said.

South Texas

The April meeting of the chapter was held at the Brooks AFB Officer's Club. Mr. Robert M. Adams, Chief of the Bioelectronics Laboratory at the School of Aviation Medicine was the guest speaker.

Biomedical instrumentation for space flight was the topic of Mr. Adams' address. He described the Little Joe Project which is part of the Mercury Program and concerns the sending up of Mr. Sam and Miss (Mrs.) Sam. He also described the instrumentation of the Discoverer satellite used by the Army Ballistic Missile Division.

Tokyo

A Japanese General, an electronic specialist and a Tokyo Institute of

(*Continued on page* 88)

FROM SIGNAL FLAGS TO SATELLITES . . .

These symbolize 100 years of progress in military communications—100 eventful years during which the U.S. Army Signal Corps has met communications needs that grew ever more complex and spanned ever longer distances.

Tomorrow offers the prospect of a new and even more exciting era, through space communications. We know the Signal Corps will meet the challenge as it has in the past—with vigor, imagination and confidence.

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World Wide Communications

(*Continued from page 33*)

An analysis has been made on the basis of 12 voice channels multiplexed in time. The satellite transponder must, however, be capable of handling the peak power of the total number of channels to be accommodated in the system.

Figure 1 shows graphically the advantage of the PCM-FM-FDM System. The received carrier power versus the channel signal-to-noise for the three systems is plotted. In the case of SSB-FDM, we can see the 40 db S/N is obtained with a carrier power of about —118 dbw. The FDM-FM system with a peak modulation index of 4 requires 9 db less power. The PCM-FM system offers considerable power reduction. The input level required here is —148 dbw or a 30 db improvement over the SSB system.

By using synchronous detection, the PCM-FM threshold carrier level is actually lower than the SSB carrier level required for the 40 db S/N ratio.

(3) *Satellite Systems*

The parameters of the communication system must be coupled to a satellite in an appropriate orbit.

Of the many satellite configurations possible, the polar, the inclined and the equatorial orbits at low altitude and at the synchronous altitude are most important.

Satellites in a low altitude orbit, 500 to 4000 miles, circle the earth in 1¾ to 4 hours; whereas in the synchronous orbit at 22,300 miles, the orbital period is 24 hours and the satellite is apparently motionless with respect to the earth.

The plane of the satellite orbit must pass through the center of the earth. The angle the orbital plane makes with the earth's equator may vary force zero degrees (equatorial orbit) to 90° polar orbit.

The low altitude satellites travelling at high speeds, relative to the earth's rotation, are visible to a limited area of the earth. The portion of the earth serviced increases with altitude and the latitude encompassed during flight around the earth is a function of the inclination.

To maintain continuous service between two points would require a number of satellites spaced along the orbit. For instance, at 4,000 miles altitude, more than 20 satellites randomly spaced in an equatorial plane would be required to assure a service interruption of less than 1% assuming stations at latitude of less than 50 degrees.

Coverage of the far north would better be served by polar orbiting satellites or those in inclined orbits of 45°.

The orbital motion of the low altitude satellite will impose a system problem of tracking, traffic switching, and coordination of orbit information. Any two stations desiring to communicate with each other must simultaneously acquire and track the satellite. The ground stations must switch to a satellite coming into view from a satellite passing out of view with a minimum service interruption.

Three satellites in an equatorial orbit at 22,300 miles can cover about 98% of the earth's surface. For a world wide communication system, this is attractive.

24-Hour Orbit Active Satellite

At the synchronous orbit altitude, the satellite antenna beamwidth for hemispherical coverage is 18 degrees, see Figure 2. Allowing a margin for attitude control error of ±3°, a 24° beamwidth yielding a gain of 16 db at 2000 Mc can be used. With 60 foot parabolic reflectors on the ground and a receiving system noise temperature of 95°K, transmitter power of 0.117×10^{-3} watts per Kc of bandwidth will yield a carrier-to-noise ratio of 15 lb.

It should be possible to arrange a time division system to handle as many as 960 voice channels. For such a system a satellite transmitter of approximately 3 watts output would suffice.

The total payload weight of this satellite carrying sufficient fuel for station keeping for a two year period would be under 400 lbs.

Initially, a world wide system channel allocation could be arranged as shown below:

Atlantic Satellite Channel Requirements

England	144	Puerto Rico	24
Germany	96	Argentina	24
France	72	Brazil	24
Italy	24	Venezuela	36
Switzerland	24	Colombia	24
Belgium	12	Bermuda	12
Denmark	12	Dominican Republic	6
Netherlands	24	Ethiopia	6
Norway	12	Union of South Africa	6
Sweden	12	Belgian Congo	6
United States	288	Morocco	6
Cuba	24	Nigeria	6
Bahamas	12	Egypt	6
Inter-Sector	18	Total	960

Pacific Satellite — **Indian Ocean Satellite**

Hawaii	48	Central Russia	96
New Zealand	36	China	36
Australia	72	Borneo	12
Japan	72	Saudi-Arabia	6
Philippines	48	Turkey	6
Eastern Russia	48	Israel	6
New Guinea	12	Greece	6
Alaska	12	India	36
		Pakistan	6
		Afghanistan	6
		Iran	6
	348		222
Inter-Sector	36	Inter-Sector	18
Total	384	Total	240

The channel allocations are based on linking small, as well as large countries which are separated by natural or political barriers.

Traffic must be regulated carefully to avoid overloading the satellite. To accomplish such traffic control, initially, a semi-automatic switching system will be part of each ground station. However, in the future, it is expected a central computer in each sector would automatically allocate channels. International agreement on usage would be imperative. But this problem is certainly no more critical than the present high frequency allocations and interference problems.

We have briefly touched on the need for and the factors affecting the design of a communication system using satellite repeaters. An active system to handle as many as 1000 voice channels can be implemented with present electronic and booster art. These satellites can compete economically and technically with other reliable systems such as submarine cables.

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[1] *The World's Telephones* 1959. Published by the American Telephone and Telegraph Company.
[2] *Reference Data for Radio Engineers*, 4th Edition, p. 763, ITT Company.
[3] *Ibid.*, p. 749.

NEWS ITEMS AND NEW PRODUCTS

The rules covering the use of priority ratings for defense contracts and orders were revised recently by the Business and Defense Services Administration, U. S. Department of Commerce. The revision effected by Amendment 6 to BDSA Regulation 2 provides additional insurance against materials delivery delays which might hinder space, defense and atomic energy projects.

The change brings BDSA Regulation 2, the basic rules of the priorities system, into conformity with the recently revised Defense Materials System Regulation 1, by making mandatory the use of priority ratings —which serve as defense identifications—in connection with the acceptance and fulfillment of defense contracts and orders. The use of ratings under BDSA Regulation 2 was heretofore permissive. The only exception to the mandatory rule is an optional exemption for purchase orders of $500 or less.

The new Amendment 6 also permits the use of estimates in determining the quantity of materials required to replace inventory stocks used to fill rated orders, thus simplifying the problem of replacement of inventory for such purposes.

William A. White, Sr., Administrator of BDSA, said that issuance of the new Amendment 6 is only an interim action pending complete revision of BDSA Regulation 2 which is now under way.

• • •

Electron tubes and semiconductors of United States manufacture have a good reputation abroad and the brisk market that has been established for products of specialized types and technically advanced design holds further promise, the Business and Defense Services Administration, U. S. Department of Commerce has reported.

A nine-country survey, *Electron Tubes and Semiconductors; Selected European Countries*, prepared in BDSA's Electronics Division, shows that American producers are supplementing their U. S.-based marketing operations in some cases by establishing European outlets either through licensing arrangements or by direct investment.

The survey was based primarily on information obtained from the U. S. Foreign Service. It covers Austria, Belgium, Denmark, France, Italy, Norway, Sweden, Switzerland and the United Kingdom.

This report is the first of a series of three publications being prepared in the Electronics Division. It is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. The price is 25 cents.

• • •

Future Development of the San Francisco Bay Area, 1960-2020 is an extensive and unusual report recently submitted for printing by The Department of Commerce. This report, prepared by the use of newly developed projection techniques, is designed to show, on a decade to decade basis, how the San Francisco Bay Area can be expected to grow from 1960 to 2020. It provides population projections during this period for the Bay Area as a whole and for nine countries of the Bay Area and their townships (including 20 maps showing the distribution of these populations). In addition, the report includes an appraisal of the future economy of the Bay Area with estimates of future employment in the major economic activities, projections and mapped distributions of various land uses by decades and a study of land reclamation possibilities.

In preparing these studies, extensive data and information on the Bay Area and Western States were obtained from city and county planning agencies, universities, banks, railroads, utilities, foreign traders, industry, wholesale and retail groups, real estate and land developers and local, State and Federal Government agencies.

This comprehensive report should be of considerable value to civic, governmental and business groups and others interested in the economy of California in general and the San Francisco Bay Area in particular. It should also prove of interest and value as a pilot study, to planning groups, chambers of commerce, realtors, financiers and other businessmen throughout the United States.

Due to the costs involved in publishing this report and the 20 accompanying maps, it is probable that only one printing can be made. Because of this fact, advance orders will determine the total number of copies printed, in an effort to ensure that all who may need and desire this report can obtain a copy. The price will be $11.00 per copy for the report and maps boxed as a unit for ready reference.

Orders and remittances may be submitted to the Superintendent of Documents, U. S. Government Printing Office, Division of Public Documents, Washington 25, D. C.

• • •

The United Kingdom and the United States have begun coordination of their Time and Frequency transmissions.

Coordination was begun early this year in order to help provide a uniform system of time and frequency transmissions, which is needed in the solution of many scientific and technical problems in such fields as radio communications, geodesy, and the tracking of artificial satellites.

Participating in the project are the Royal Greenwich Observatory, the National Physical Laboratory and the Post Office Engineering Department in the United Kingdom, and, in the United States, the U.S. Naval Observatory, the Naval Research Laboratory and the National Bureau of Standards. This program follows previous cooperative efforts of these agencies to achieve uniformity and simplification in procedures.

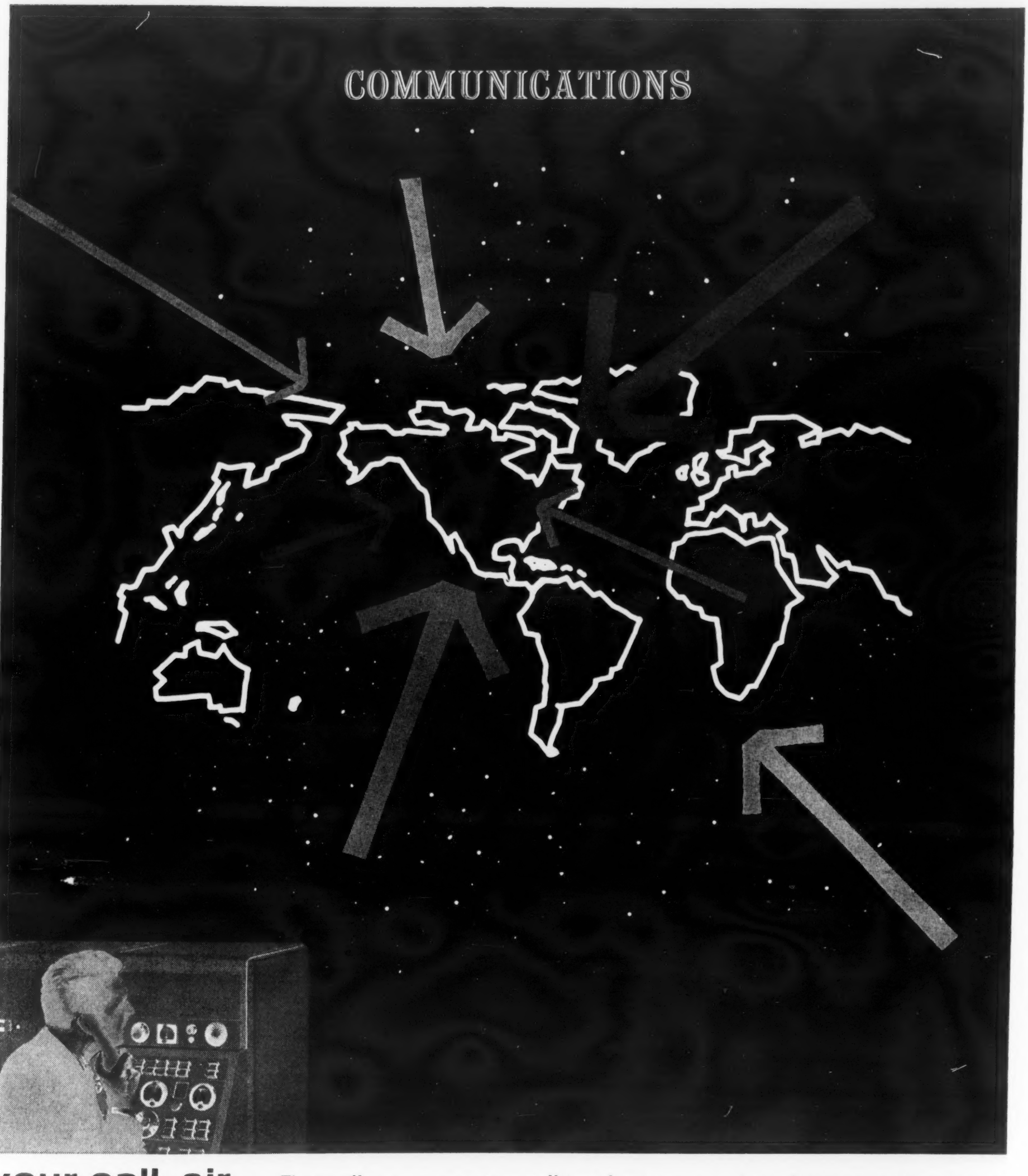
The transmitting stations which are included in the coordination plan are GBR and MSF at Rugby, England; NBA, Canal Zone; WWV, Beltsville, Maryland and WWVH, Hawaii.

Coordination began in January. It is expected that by the end of 1960 the time signals from all the participating stations will be emitted in synchronism to the thousandth of a second. Such accuracy has been needed for some time in tracking artificial satellites on a world-wide basis.

• • •

A new weapon system has been jointly announced by the Navy and Westinghouse Electric Corp., prime development contractor for the weapon control subsystem.

Designated Typhon, after a fierce hundred-headed monster from Greek mythology, the new system is designed to provide the fleet with an improved anti-air warfare capability and an offensive capability for engaging enemy fleet units and conducting long-range shore bombardment.



your call, sir... That call may come via satellite relay or over a long-distance scatter circuit. It may originate from robot-like circuitry—or come from deep outer space. There's a revolution going on in communications, and we at Bendix Radio have a big hand in it. We're providing communications for Task STEER and Project MERCURY; we are doing something different in scatter. We're under contract to develop unusually compact personal radios, basic transceivers for space projects, and low-noise receiver designs; we are leaders in subminiaturization and modular packaging. For the most advanced operational features available in communications, you'll do best at Bendix Radio.

Bendix Radio Division

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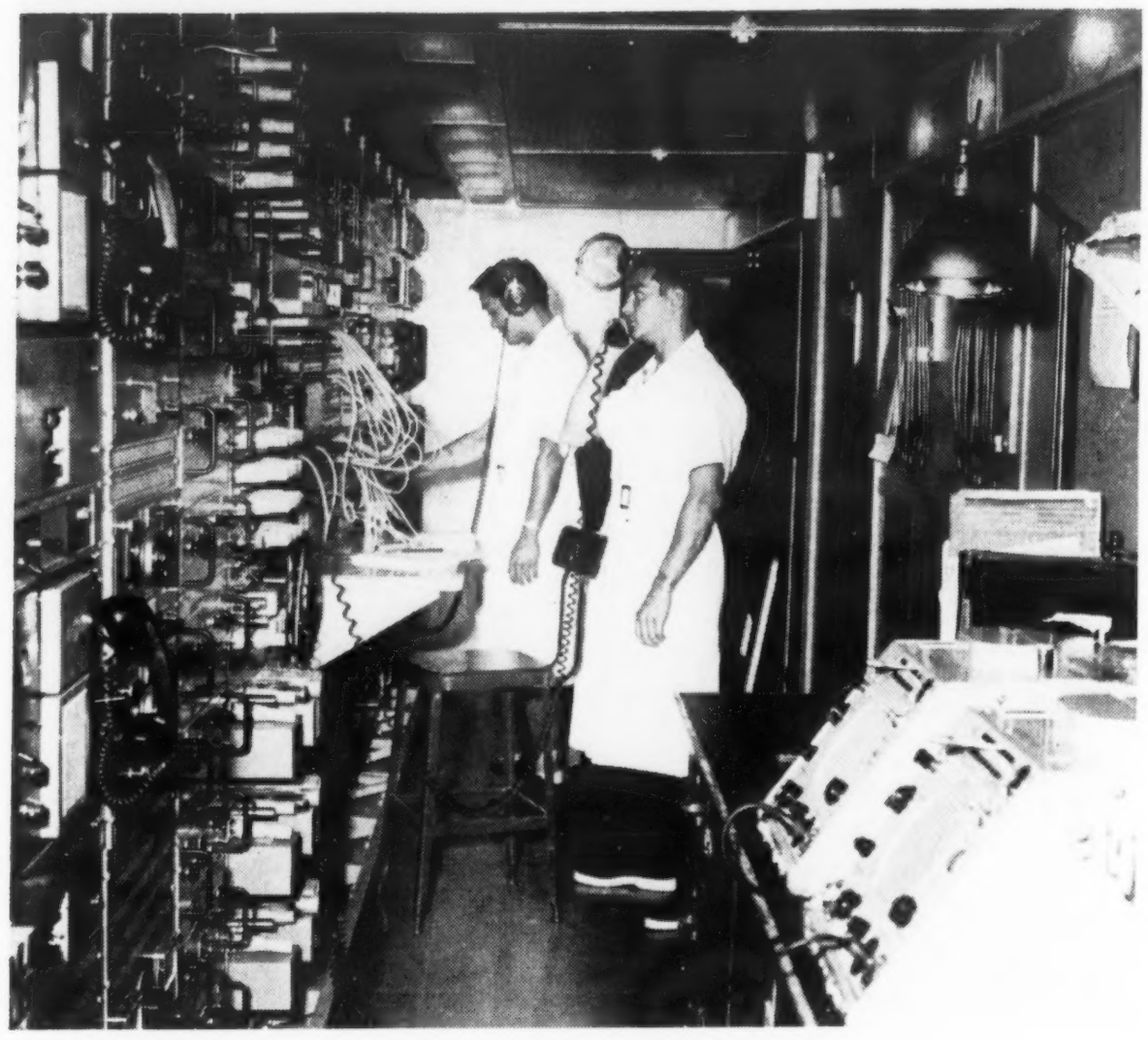


SPACE TRACK AROUND THE CLOCK!

Barking Sands, Kauai, Hawaii . . . It's one of several stations where Vought Range Systems specialists have maintained a 24-hour space watch.

Their job is to get precise, dependable data on missile and space vehicle operations. This kind of job has gotten *ten million man-hours* of attention from Vought Range Systems personnel.

Around the world, veteran Vought teams are setting examples of efficiency and economy in remote-base operation. They expedite station activation. They provide complete operational service, including inspection, maintenance, and alignment and operation of mechanical, electronic, optical and camera equipment.

STATION OPERATION IS PART OF THE FULL SERVICE offered by Vought Range Systems Division to military and space agencies, and industry. Other specialties include: **range studies, range instrumentation** (both land-based and shipboard systems), **range implementation, and drone services.** Vought contributed this full range of services in the development of the Inland Test Range portion of the Pacific Missile Range.

Find out how quickly and economically our trained representatives can meet your tracking or testing requirements. Write: S. O. Perry, Division Manager . . .

CHANCE VOUGHT RANGE SYSTEMS DIVISION DALLAS, TEXAS

The system will fire missiles from launchers mounted on fast moving warships in strategic fleet locations around the world. It will contain a new, advanced long-range, search, track and guidance radar. High speed computers will provide near instantaneous target selection and designation.

Westinghouse was awarded a $38.5 million contract for the development, design and production of a prototype model of the long-range radar portion of the system. The new radar concept was originated by scientists at the Applied Physics Laboratory of The Johns Hopkins University. The concept incorporates high data rate and high power features far in excess of present designs. This radar, together with the other elements of the shipboard weapon control system, is the major factor in the greatly improved performance of the weapon system.

• • •

Communications equipment for the McDonnell F4H-1 *Phantom II* aircraft was developed by Collins Radio. The equipment is a part of the communications-navigation-identification system which has been integrated into a single system—the AN/ASQ-19. The communications portion was derived from the Navy developed AN/ARC-52 UHF Transceiver with modifications to extend the environmental capability. The equipment provides 1750 crystal-controlled channels in the 225 to 400 MC range with 20 watts transmission output. An auxiliary, similar to the AN/ARR-40, is used primarily for automatic direction finding and as a secondary communications receiver. The auxiliary has 20 pre-set, crystal-controlled channels in the 265 to 285 range.

The F4H Communications Equipment provides direct line-of-sight communications to other aircraft and the ground throughout the full speed and altitude range of the aircraft (although speed—which in the case of the F4H-1 is in excess of Mach 2—has no effect upon the communications envelope). The equipment has been designed to operate continuously at altitudes up to 60,000 feet. Actual flight experience has shown satisfactory performance at altitudes in excess of 70,000 feet.

The McDonnell F4H-1 *Phantom* is an all weather turbojet type fighter armed with Sparrow missiles.

• • •

Major General D. W. Hutchison, Commander of Tactical Air Command's Ninth Air Force, speaking recently at the opening session of the

fifth annual Communications and Electronics Conference at Orlando Air Force Base, Florida, told the nearly 200 Air National Guardsmen C&E personnel in attendance that their job "is a vital one to U. S. survival" in this day of push-button warfare.

General Hutchinson re-emphasized the "readiness" concept of the inactive forces in the United States, pointing out the "essential unit of purpose and action for both the active and inactive forces in the event of an emergency."

He also reminded the guardsmen and their advisors of the course of action this nation faces in event of enemy attack.

"Strategic Air Command will have 15 minutes to get off the ground from the time (the aggressor) starts to move," he said, "(and our) communications and electronics people will have 90 seconds of that 15 minutes to detect the move and alert the Air Force-SAC, Air Defense Command and TAC.

". . . Viewed in this light, communications and electronics failures are weapons failures—failures where we *must* have 99.99 per cent reliability or the weapons are not good enough."

Thus General Hutchison officially opened the conference following his introduction by Colonel John A. McVey, Ninth Air Force's host for the event.

• • •

Because of the demand for this type of training, three more Staff College Courses in *Industry Defense and Mobilization* have been scheduled for 1960 at the Office of Civil and Defense Mobilization National Operational Headquarters in Battle Creek, Michigan. The dates for these courses are June 6-10, August 22-26 and November 14-18, 1960.

The courses are sponsored by the OCDM Industry Office which is responsible for providing encouragement, information and technical guidance to business, commerce and industry on methods of preparing for survival and continuity of production following enemy attack or other major disaster.

In the event of nuclear attack on this country our survival will depend to large extent on the ability of American industry to protect its employees and plants, preserve its corporate structure and take measures for restoration which will ensure continuity of production. This course will provide industrial executives and government officials with practical information and training in practices and procedures for protection from nuclear attack and major peacetime disaster in industrial plants, institutions and office buildings. Thus, it will help industrial firms achieve a greater measure of security through survival planning, and thereby give greater assurance of national survival.

The course is open to all who have responsibility for emergency and disaster control planning in industrial plants, institutions and other large buildings and facilities. They include industry defense coordinators, personnel directors, safety directors, training directors, security supervisors, plant protection officers, State and city industrial defense coordinators and others who have related responsibilities.

For information to enroll and register for the OCDM courses, write to your local or State civil defense director, or to the Industry Office, Office of Civil and Defense Mobilization, Battle Creek, Michigan.

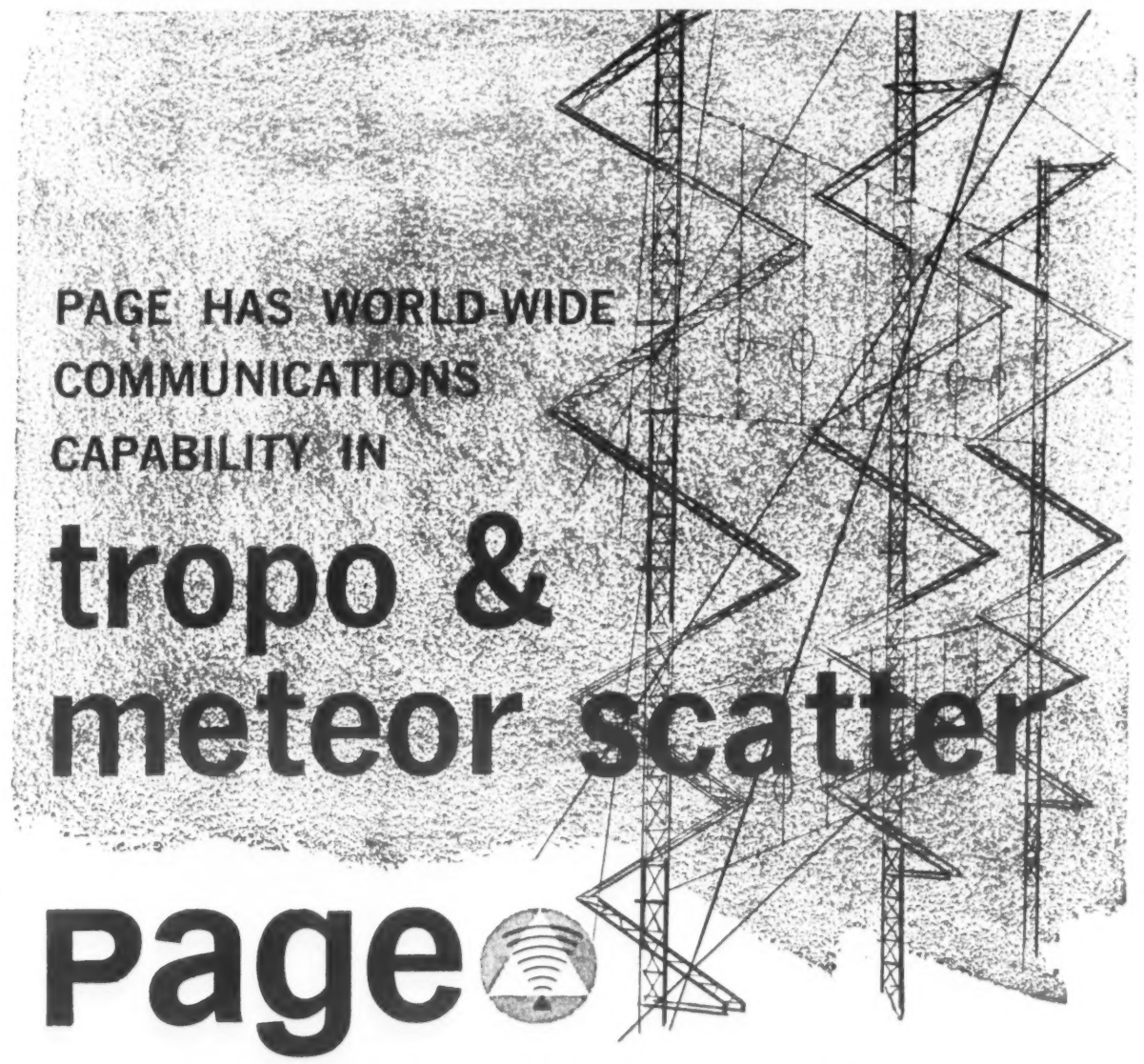
• • •

Engineering models of equipment called DISCOM (Digital Selective Communications) are being built by General Electric's Communication Products Department at Lynchburg, Va. for test by the Air Force. The new system is expected to permit airplanes to communicate canned "book" messages for the first time using digital transmission methods. Display of the information visually enables pilots to see messages on their instrument panels at greater distances from the control base and to communicate long range at points where voice conversations might be indistinguishable due to poor signals and high noise conditions.

DISCOM combines advanced communications techniques with computer-type technologies, relying heavily on sensing and information storage processes, including magnetic cores and memory devices. Only solid state components, transistors and diodes are used—no tubes.

• • •

The Sixth Annual Conference on Magnetism and Magnetic Materials will be held in New York City, November 14-17 at the New Yorker Hotel. This conference is sponsored jointly by the American Institute of Electrical Engineers and the American Institute of Physics, in cooperations with the Office of Naval Research, the Institute of Radio Engineers and the Metallurgical Society of the AIME.



An Important Announcement

for Executives and Officers

CREI ATOMICS CAN TRAIN YOUR ENGINEERS AND TECHNICIANS FOR THE NUCLEAR AGE

CREI Atomics, a division of the Capitol Radio Engineering Institute, invites government and industry executives, engineers and personnel directors to write for a complete catalogue of curriculum and facts about the CREI Atomics home study program in NUCLEAR ENGINEERING TECHNOLOGY.

Your professional activity will be affected, directly or indirectly, by the increasing use of nuclear power. The Atomic Energy Commission states about the severe shortage of trained people in this field: " . . . the immediate goal is to retrain, through short courses . . . those already grounded in traditional disciplines." The CREI Atomics home study program is designed to help individual engineers and technicians accomplish this goal.

Program of study includes—Nuclear Physics, Reactor Physics, Thermodynamics, Reactor Technology, Reactor Controls, Instrumentation for Reactor Controls, Isotopes, Health Physics—many other subjects.

For detailed information, address your inquiry to Mr. E. H. Rietzke, President.

CREI Atomics

DIVISION OF THE CAPITOL RADIO ENGINEERING INSTITUTE

3224 16th Street, N.W. Washington, D.C.

Authors should submit titles and abstracts of proposed papers by August 26 to A. M. Colgston or R. C. Fletcher, Program Chairman, Bell Telephone Laboratories, Murray Hill, N.J. Further conference details can be obtained from the Local Chairman, L. R. Bickford, Jr., IBM Research Center, Yorktown Heights, N.Y.

• • •

A Band Shift Modulator developed by Rixon Electronics, Inc., of Silver Spring, Md., can filter and translate the audio spectrum into frequency bands which can be examined individually and simultaneously with a high degree of resolution. The filtering and translation is accomplished by an adaptation of a Quadrature Function translator technique which is described in the February Rixon Engineering Bulletin, Number 67.

Thirty-five individual translator units are assembled into a two-rack assembly to provide complete instrumentation for the selection and translation of thirty-five 11 c/s wide spectrum segments falling between 150 and 5000 cycles/second. The overall unit consists of 7 five-channel assemblies operated from a common power supply. An input filter unit is also provided as a means of rejecting particular spectrum portions which may contain high-intensity signals and be of relatively low interest. It is therefore possible to add or subtract channels in groups of five.

• • •

An advanced fully automatic data transmission system designated CODIT (*CO*mputer *DI*rect To *T*elegraph) was demonstrated recently at the Air Force Missile Test Center.

Now in operation to transmit predicted trajectory data from Cape Canaveral, launching site of ballistic missiles tested on the Atlantic Missile Range, to radars positioned along the 5,000 mile range, CODIT proved its capability of providing accurate reduced data to radars at strategic points on a world-wide range or to data analysis centers anywhere in the world.

Developed by RCA engineers at the Air Force Missile Test Center, CODIT utilizes presently operational systems in providing automatic data reduction and transmisison at high speed. Complete automation removes any possibility of human error, while use of existing range and commercial communication systems provides low cost operation. By reducing the data prior to transmitting over a commercial system, the volume of data may be limited to that required, while needless volume would be sent over great distances if the entire data collection were transmitted.

In the recent Atlantic Missile Range demonstration, simulated ballistic missile tracking data were transmitted from Ascension Island, 5,000 miles from Cape Canaveral, received by a CODIT receiver at the Cape and automatically reduced by a high speed computer. Again untouched by human hands, the reduced data were fed directly from the computer into a commercial land line teletype system that immediately displayed the reduced data at the Air Force Air Research and Development Command's National Space Surveillance Control Center, Cambridge, Mass. The reduced data were read in Cambridge less than 30 seconds after the raw data were transmitted from Ascension Island.

• • •

The Air Force MARS Western Technical Net has announced the following schedule for June:

June 5: "Beginnings of Interplanetary Flight," by Dr. Aubrey Micklewait, Space Technology Laboratories, Inc.

June 12: "Preferred Electronic Circuits," by Capt. John Ellison, USN (Ret.), Director, USAF MARS Western Tech. Net.

June 19: "The Able Series of Space Probes, Pioneer I, Explorer VI, Pioneer V," by Eugene R. Spangler, Space Technology Laboratories, Inc.

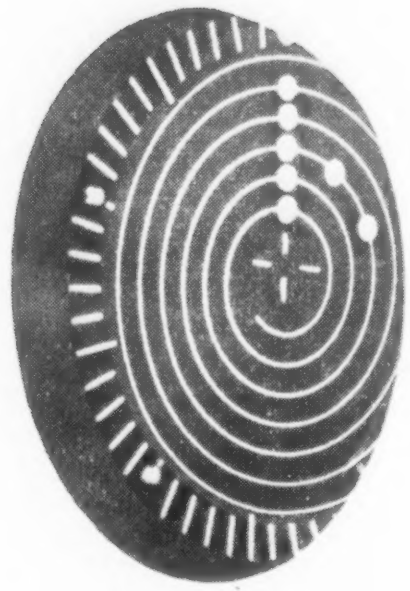
June 26: "Final Net Session for Current Season." Open membership session.

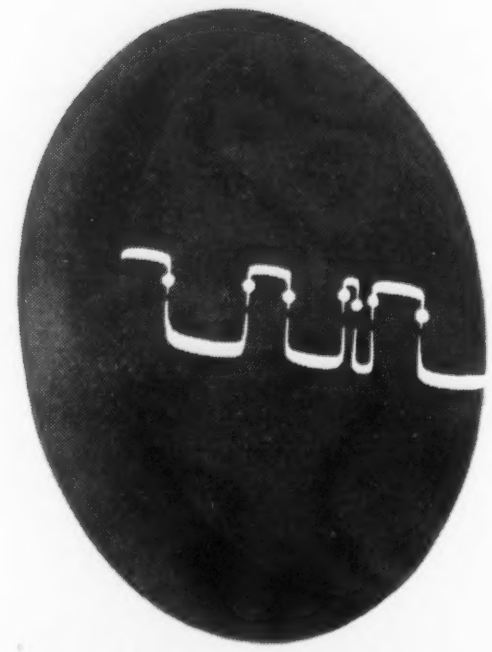
The net can be heard each Sunday afternoon from 2 to 4 PM PDST on 7832.5 kcs., 3295 kcs and 143.46 mcs. The net will not operate during July and August and will resume activity September 11, 1960.

• • •

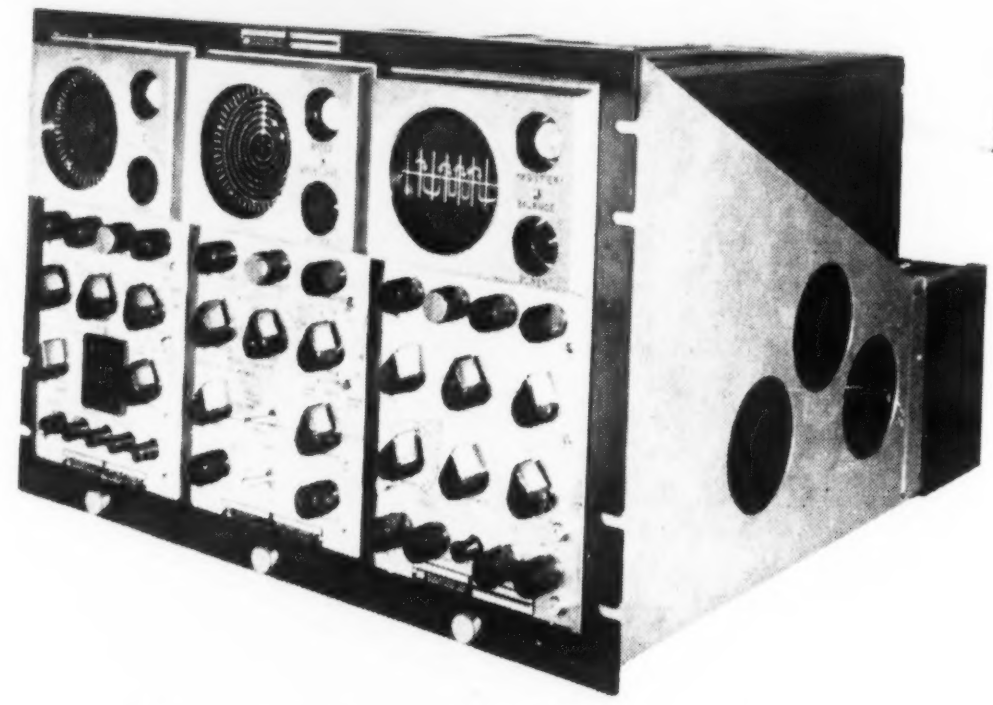
The Sonotone Corporation has recently introduced a sintered plate nickel cadmium battery which is rechargeable. The battery carries a written guarantee by the company for five years satisfactory operation. However, the company believes that fifteen or twenty years is a more likely life expectancy. In addition to this standard replacement for two regular flashlight cells, it has a continuous burning life of 90 minutes with a PR 4 or PR 6 bulb; the company is also putting out a heavy duty battery of the same size and weight, with double the burning life, which sells for $2 more than the list price of the regular battery, which is $7.95.

The company has gone to consider-





WHAT'S WRONG WITH THIS TELEGRAPH SIGNAL?



...and how do you find out without interrupting traffic?

The answer to the second question is Radiation's TDMS—Telegraph Distortion Measurement System—a compact, self-contained unit for on-line testing, analysis and monitoring of telegraph and data transmission links.

The TDMS detects, measures and analyzes signal distortion on a continuous basis, alerts even a non-technical operator that a circuit is deteriorating. Thus pinpointed, the malfunction (a badly-tuned receiver in a radio link, for example) can often be corrected with little or no circuit downtime.

For detailed information on the TDMS, write for Bulletin RAD E-100B to Radiation Inc., Melbourne, Fla. Address Dept. S-6

WHAT'S WRONG WITH THE SIGNAL SHOWN ABOVE? Character (letter R) shows a split 4th element, a result of poorly adjusted transmitting equipment. Spiral trace display on Telescan CRT (at left) indicates the presence, and analyzes the nature of characteristic distortion.

THE ELECTRONICS FIELD ALSO RELIES ON RADIATION FOR...

RADIPLEX–50-channel low-level multiplexer with broad data processing applications. Features rugged solid-state circuitry, almost unlimited programming flexibility, unique modular construction for compactness and exceptional ease of operation and maintenance.

RADICORDER–Multistylus recorder provides high-speed instantaneous readout for wide range of data acquisition or processing systems. Eliminates necessity of electronically translating complete data, thereby reduces computer work loads.

TELEMETRY TRANSMITTER–Model 3115 is a ruggedized 215-260 MC unit with extremely linear FM output under the most severe environmental conditions. With its record of outstanding performance in many missile programs, Model 3115 is specified by leading missile manufacturers.

RADIATION INCORPORATED

able expense to introduce automation in producing this battery, and for this reason, they are concentrating on the single 2-cell unit as well as small batteries of other sizes. The batteries have been used to power toys, electric shavers, small electric fans, portable radios and flash guns for photographic work.

The battery itself is designed to stand up under 30 G's, to withstand the shock of take off of a rocket or a missile. It is encased in a steel case which is leakproof and prevents any possibility of corrosion. This factor should prove of importance in the area of expensive electronic gear, where standard batteries, which may be left too long in a piece of equipment, may corrode and freeze in place, ruining a valuable mechanism.

• • •

Vernon Industries Limited of Liverpool, England has developed a brushless alternator system. According to the company, development of the new system was brought about by the need for a range of very high performance ground power supply units for use with the large civil jet aircraft now coming into service.

It was necessary to provide a range of 400 cycle alternators and control systems which would have good waveform, very good voltage regulation and response to voltage variations resulting from full load switches. In addition, these sets should be completely reliable and require little maintenance. The brushless alternator seemed to offer an outstanding number of advantages, such as the elimination of carbon deposits on windings, brush and slip-ring maintenance and defects caused by humid or sandy operating conditions. The mechanical construction of the brushless alternator is much simpler than the slip-ring type and is correspondingly simpler to produce, the company reports. The employment of very lightly loaded bearings in the alternator would ensure that once fitted, they could be forgotten.

The system of voltage control which was evolved makes the fullest use of new components and techniques. Both the rotating machine and control system design were fully integrated at all stages to ensure that the maximum advantage was obtained from the recent advances in these fields.

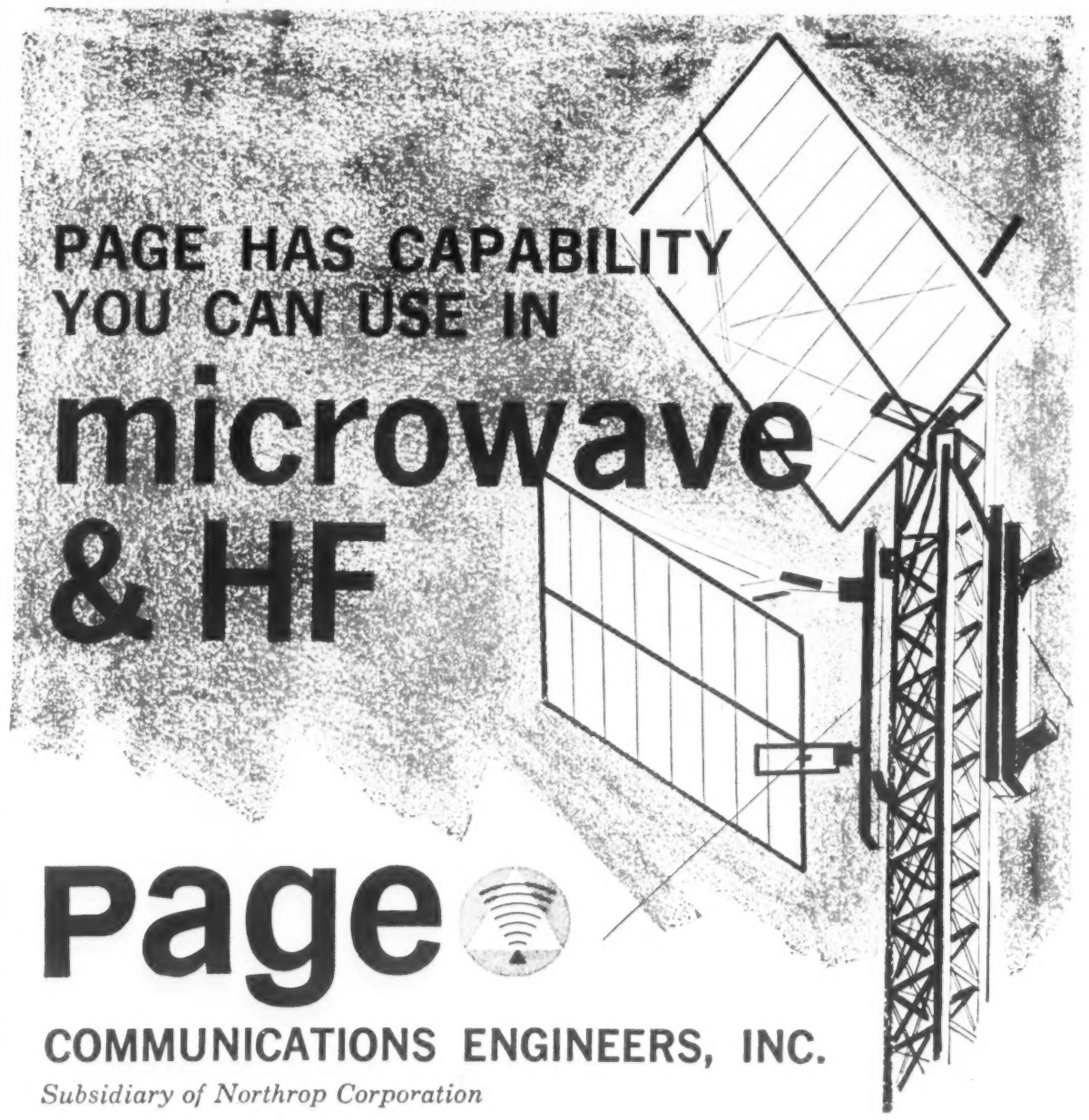
The alternator-rotating amplifier assembly comprises the following: the stator, which carries the field windings of the AC rotating amplifier and the output windings of the main alternator; the rotor, which carries the AC rotating amplifier output windings, a silicon power rectifier assembly and the field windings of the main alternator. A power transistor in the output stage of a Vernon Transistor Regulator controls the AC rotating amplifier field current. During operation the transistor regulator responds to input signals from main alternator output. These signals are compared to a voltage reference source and any measured deviation from the predetermined level causes the regulator to correct the field current level. A change in rotating amplifier field current causes a corresponding change in the level of its output voltage. The rotating amplifier output is rectified by the silicon power rectifier assembly and the resulting DC voltage is applied to the main alternator field, causing the alternator output to return to its preset regulated value.

• • •

A new wideband recording system which has a greater frequency response than their Videotape TV recorder has been developed by the Ampex Corporation. The system, developed principally for military and scientific applications, has both an airborne and ground unit.

The airborne unit, capable only of recording, is known as the AR-300 and consists of a tape transport and a power supply. The ground unit, a complete recording and reproducing system, is known as the FR-700. The FR-700 can be operated independently of the AR-300, or can be used as the reproduce equipment for tapes recorded in the air. For some applications, the FR-700 will be used to provide ground support for several AR-300's. Both units are capable of recording two channels of wideband information over the frequency spectrum from 10 cycles to 4 megacycles. Amplitude response is flat to within 3 db over this frequency range. The new system also records two auxiliary channels of information with a frequency response from 200 cps to 15 kilocycles.

Solid-state components and etched circuitry are used throughout the system. This has permitted reductions in size and weight over the Videotape recorder which displaces nearly 100 cubic feet. The mobile AR-800 record system displaces 3.5 cubic feet and weighs less than 150 pounds including tape. The FR-700 recorder-reproducer mounts in a standard 19-inch wide electronics rack and uses approximately 4 feet of rack space for tape transport and electronics.



ALDEN SCANNERS MARK NEW ERA IN FACSIMILE COMMUNICATIONS

Compact, mobile Alden Flat Copy Scanners are in use today throughout the U. S. Weather Bureau Hi-Altitude Facsimile Network — marking a bright new era of simplified, continuous facsimile communication. And here are the reasons why —

NEW INSTALLATION SIMPLICITY . . . within two hours of air delivery, Alden Scanners at the Hi-Altitude Network were uncrated from their fold-away shipping cases, rolled in, plugged in, and *fully tested* for 60, 90, and 120 RPM quiet and dependable operation.

NEW COPY HANDLING SIMPLICITY . . . map transmission is no longer dependent on exact drum mounting. With Alden's expandable copy feed head, maps of *any width or length* can be scanned, one after the other, fed straight or crooked, *with only one Alden Scanner.* Original plotted maps can now be scanned without cutting to size. Map plotters have originals returned in half the time. Space and maintenance problems are minimized.

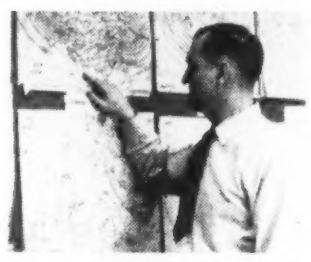
NEW CLARITY — NEW SHARPNESS . . . with copy feed rolls precisely positioning surface of the map on the flat copy scanner table, exact focal lengths are maintained for clear, sharp recordings. Focus smudge caused by unusually thick copy or copy lifting from drum is *completely eliminated.*

MEETS ALL FUTURE REQUIREMENTS . . . the practical scanning equipment for a world-wide facsimile map network. Speeds can be easily increased — without reengineering of equipment — for use with coaxial or microwave transmission facilities and computer-processed weather data.

WHAT ARE YOUR FACSIMILE REQUIREMENTS? LET'S GET TOGETHER . . . Alden Flat Copy Scanners and Recorders are available in all sizes (and up to 30 times present network speed) to users and qualified manufacturers. Your inquiry is invited.

HERE'S WHY FORECASTERS PREFER* ALDEN RECORDERS AND ALFAX MAPS AND WHY WE THINK YOU'LL LIKE THEM TOO!

MOST COMMENDED FEATURES OF ALFAX MAPS



Color Is Easiest To Read Under All Lighting Conditions

Ease Of Writing And Erasing Enhances Analysis

Clean Crisp Duplicates By Bruning Or Ozalid

PLUS THESE UNIQUE FEATURES

LOW COST . . . Alfax papers save 1/3 to 2/3 yearly paper costs.

CLEAN . . . Electricity is the Ink . . . ion deposits make crisp brown marks on clean white background — free from dust, smudge and chemical irritants.

PERMANENCE . . . Alfax stores indefinitely . . . recording marks are permanent.

*In surveys of weather forecasters experienced with all weather facsimile systems, 3 out of 4 indicated a marked preference for Alden Recorders and Alfax Maps.

MOST COMMENDED FEATURES OF ALDEN RECORDERS

EASE OF INSTALLATION
Compact, mobile, and ready for immediate operation.

Uncrate

Roll in

EASE OF MAINTENANCE

Front panel checks

Back connector checks

Plug-in construction

EASE OF OPERATION
A new high in clean, quiet, trouble-free operation

Instant Visibility

Easy Paper Loading

Automatic Time-Clock Programming

PLUS THESE UNIQUE FEATURES

SECURITY . . . Low voltage marking process does not generate a signal that can be intercepted.

HIGH SPEEDS . . . Sixty, 90 or 120 RPM operation — recorder technique and paper capable of 15 times these existing speeds.

VOLUME PRODUCTION . . . Designed for volume production on short lead time through unique expandable manufacturing processes.

CEILOMETER BREAKTHROUGH

Used with rotating beam ceilometer, Alfax paper and Alden recording techniques replace continuous live scope observation with a continuous pictorial history of cloud conditions. Dynamic tone-shade gradients in warm color reveal all pertinent ceiling information in easy-to-read, easy-to-interpret form. Superimposed dark maximum signal marking shows exact reportable cloud height.

ALDEN ELECTRONIC AND IMPULSE RECORDING EQUIPMENT CO., INC.
Alden Research Center **Westboro, Mass.**

Transistor advances played a significant part in the development of the system and permitted the airborne recorder to fall within the portable category. Ampex engineers contend that without recent transistor progress by Philco, Westinghouse, Fairchild and General Electric, complete transistorization of the system would not have been possible.

The first units have been shipped to the Aerospace Technical Intelligence Center, Wright-Patterson AFB, Dayton, Ohio. Their development was accelerated under the terms of a USAF contract for use in special Air Force projects. Although only two years of design and development time are directly involved in the accelerated program, the recorders represent over four years of continuous research in wideband recording techniques by the Corporation.

Photoprogress

The new radar photography system, designated the AN/UPD-1, is an important step in providing an improved combat intelligence system for the field army. With its side-looking operation, scanning enemy territory at right angles to the aircraft's direction of flight, it produces map-like photos for intelligence study.

Objects which are near to each other, such as military vehicles, can be picked out on this map at ranges greater than previously possible. The main departure from conventional radars and photography is this ability to "see" adjacent objects without distortion due to distance.

The system is made up of conventional components which are carried in an L-23D Army aircraft and a ground-based Army van. The aircraft carries a radar with a side-looking antenna, radar signal-storage equipment and a special doppler-inertial system to provide an effective straight-line flight path. The mobile van contains film-processing equipment and an analog computer that converts the stored radar data into the final radar strip map. The airborne components of the system weigh seven hundred pounds.

The aircraft flies a straight-line path while the side-looking antenna of the radar scans a wide strip of terrain along the distant horizon in a continuous operation. The returning radar reflection pulses are continuously recorded on a signal storage film, which constitutes the input to the ground-based analog computer. This computer converts the radar signals on the storage film into a detailed, distortion-free strip map upon which terrain and objects appear as if mapped from directly overhead, except, of course, for normal radar shadowing effects.

The AN/UPD-1 is not only capable of achieving a fineness of resolution that is ordinarily unavailable from a small, airborne antenna emitting a broad beam, but represents a significant departure from photography and conventional radars in that its azimuth resolution is range-independent.

Range resolution is achieved by conventional pulsing, but the physical limitations on the size of an airborne antenna and thus the limitations on the azimuth resolution are overcome by the synthesis of a side-looking antenna. Just as a camera with a large aperture requires focusing to obtain a sharp picture, so too does a radar require focusing to get fine azimuth resolution. In the AN/UPD-1 the radar is not only focused, but it is focused simultaneously at all ranges. Although the airborne antenna used in the system is only five feet long, it is possible to synthesize an antenna many times the length of the aircraft.

The concept of the AN/UPD-1 system was originated in 1953 by Dr. Louis J. Cutrona, head of the Radar Laboratory of the Willow Run Laboratories. The ground-based data-processing equipment was engineered and built by Willow Run Laboratories. From specifications provided by Willow Run Labs and under a subcontract with The University of Michigan, the airborne components of the system were engineered, built and installed in the L-23D aircraft by Texas Instruments Incorporated.

* * *

An aerial camera, the KA-30, combines the capability to perform day or night into a single unit thereby eliminating the need for two cameras in military reconnaissance flights.

Chicago Aerial Cameras, developers of the KA-30, report the highlight of the camera is the IMC principle or Image Motion Compensation. This development freezes the picture on the film by moving the film at the same relative speed of the aircraft. This eliminates any chance of blurring caused by high speed.

Designated by the Army as standard equipment, KA-30's are already in use by Army Signal Corps drone and manned vehicles. The cameras are scheduled to join Navy fleet reconnaissance units in 1960.

(*Continued on page* 88)

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MR. JOHN KASSABIAN, Ordnance Radar Dept., Raytheon Co., Wayland Labs., Wayland, Mass.

PROCEEDINGS *really takes a beating . . .* FROM ITS READERS!

If you've been in many company libraries, we're sure you've seen "dog-eared" copies of *Proceedings*. It's not a case of poor paper and printing—we use the best quality—it's just an example of pass-along readership taken to extremes!

Of course, 57,334 (ABC) professionally qualified men receive individual copies of *Proceedings* at home each month, as well as 13,976 students in engineering colleges. What's the reason for this important following?

Proceedings of the IRE enlisted the aid of the John Fosdick Organization to take a survey of its many readers to find out what they thought. Here are some of their reactions. "We use *Proceedings* as a reference. It's really a text. Has the largest amount in proportion of text, the highest quality text, and the largest amount of informational advertising of any book in the industry." And, of special interest to advertisers, one chief engineer said, "I've saved half-a-million dollars by buying from ads in *Proceedings*, and I've bought a quarter of a million dollars worth of equipment from the ads."

Fact is, 100% of those interviewed said they have some purchasing responsibility! And, as a further indication of the effectiveness of using *Proceedings* to reach buying factors of electronic equipment, components and supplies, these readers expressed a 2 to 1 preference for *Proceedings* when compared with mentions of all the electronic books. (Survey available upon request—ask for it!)

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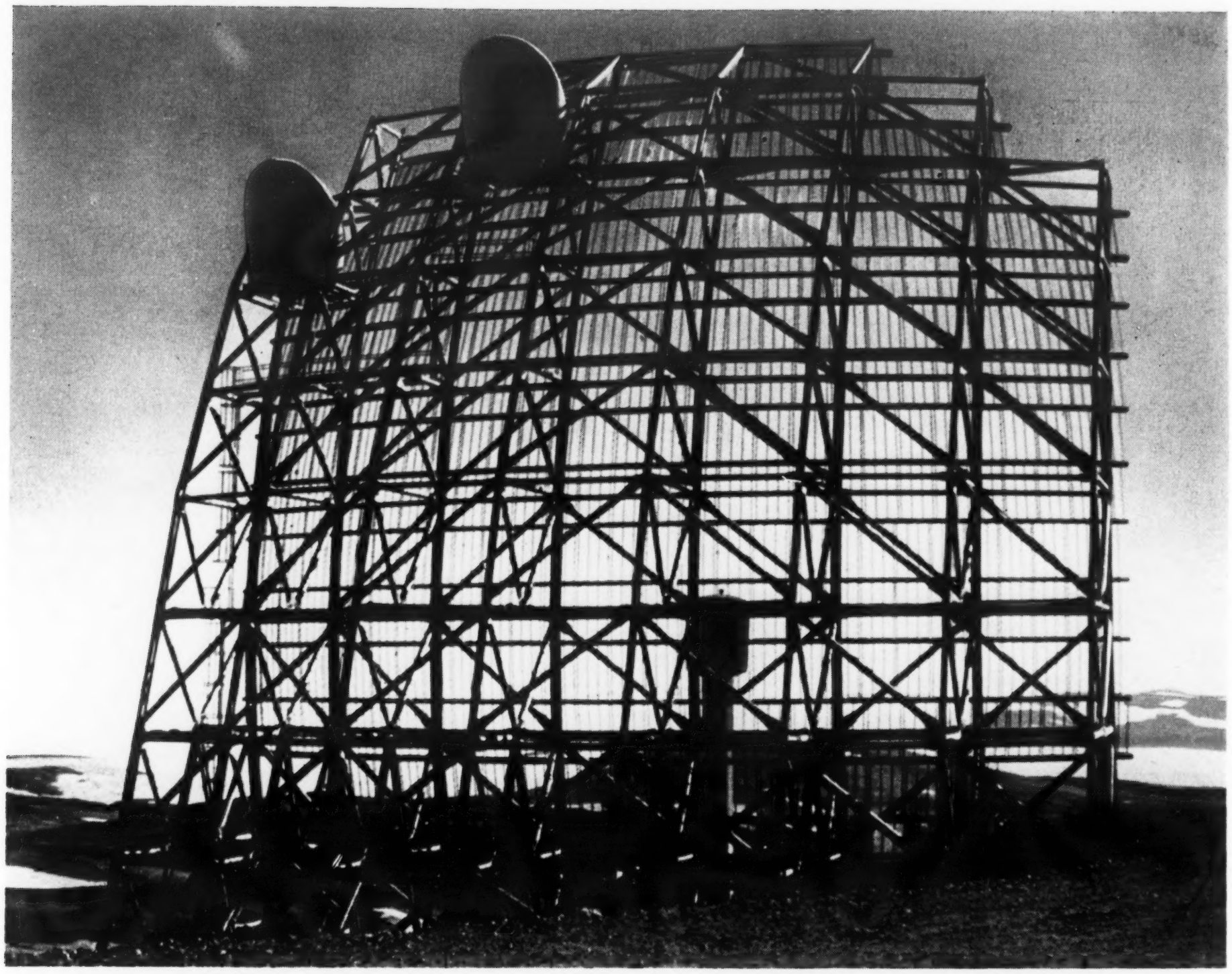

Note the offset parabolic relay antennas mounted on the tropo-scatter antenna. Designed with integral radomes protecting the feed and reflecting surface, these units were erected by KENNEDY for base communications use — another indication of KENNEDY's all-around capabilities in the antenna art.

when you're thinking about

TROPO-SCATTER ANTENNA SYSTEMS

. . . you should be talking to D. S. KENNEDY & CO.

The KENNEDY antenna pictured, is but one model of the world's most complete line of tropo-scatter antennas, including 60 foot models of steel or aluminum, 28 foot aluminum, 28 foot transportable models plus 120 footers like the one pictured.

Erected by General Electric Company's Communication Products Department in the arctic, KENNEDY antennas like this were selected for the job for several reasons:

1. **ENGINEERED FOR TOUGHEST ENVIRONMENT**: Arctic winds often exceed hurricane force, and these tropo-scatter units will withstand winds of more than 180 mph when loaded with 6" of ice.
2. **ENGINEERED FOR CONTINUOUS DUTY**: Operating tolerances are strictly maintained. KENNEDY structural know-how keeps antennas accurate under wind or ice loads.
3. **ENGINEERED TO ADVANCED CONCEPTS**: KENNEDY antennas utilize offset feed systems, separately mounted feed towers and are designed for easy erection in the field.
4. **BUILT-IN PRECISION**: KENNEDY quality control and precision construction at the plant assures minimum field time and maximum performance.
5. **COMPLETE SYSTEMS**: Wave guides, feed horn, feed tower, and reflectors are integrated into a unit by KENNEDY. This saves time and improves the performance of all the components.

D. S. KENNEDY & CO. has been associated with the design, manufacture, and erecting of the greatest variety of tropo-scatter antennas. That's why it will pay you to talk to them.

Kennedy gives you experience you can't buy elsewhere.

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TRACKING ANTENNAS • RADIO TELESCOPES • RADAR ANTENNAS • SCATTER COMMUNICATIONS ANTENNAS • MICROWAVE RESEARCH AND DEVELOPMENT • TRANSMISSION TOWERS • SWITCHYARD STRUCTURES

Chapter News

(*Continued from page 73*)

Technology graduate student received achievement certificates and cash awards for their outstanding work in the communications fields at the April meeting of the chapter.

The awards were presented to these individuals as part of the awards presentation ball held in Tokyo on April 6.

The AFCEA awards were presented to Major General Yoichiro Hiracka, chief of communications for the Japanese Ground Self Defense Forces, Dr. Leona Esaki of the Sony Corporation, and Kiyoshi Takahashi, a graduate student at the Tokyo Institute of Technology.

Attending the ball were top American military personnel and high ranking Japanese dignitaries.

Washington

The program for the May Luncheon meeting was co-sponsored by the U.S. Army Signal Corps and commemorated the Signal Corps Centennial year.

The unusual program was introduced by Major General R. T. Nelson. It included exhibits, short films and Signalmen from out of the past to highlight the accomplishments of the Signal Corps. In addition, the group was entertained by the fine singing of the U.S. Army Chorus.

Photoprogress

(*Continued from page 85*)

A brochure describing its lightweight aerial panoramic camera for wide-angle photography has been published by the Electro-Optical Division, Perkin-Elmer Corp., Norwalk, Conn. The eight-page brochure describes the operation and specifications of the camera and illustrates high resolution obtainable with it.

The camera, designated the Model 501 lightweight panoramic camera, employs rapid scanning principles to obtain successive horizon-to-horizon photographs covering 180 degrees across a plane's line of flight. Designed for diverse commercial and military applications, the camera has automatic sequencing with sufficient film capacity for a complete mission.

Names in the News

Richard L. Beam was elected executive vice president of the Hazeltine Electronics Division. Mr. Beam formerly was executive vice president for engineering of the division.

J. Harry Labrum and **Major General George I. Back**, USA. (Ret.), former chief signal officer, were appointed consultants on military contracts to the National Electronics Facilities Organization.

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Robert L. McCormack has been elected vice president and general manager of Industrial Components Division, Raytheon. Prior to his promotion he was general manager of the division.

Theodore M. Douglas has been elected a vice president of the Laboratories of the International Telephone and Telegraph Corporation. In 1958 he was named vice president of sales and was elected vice president-operations manager early this year.

James L. von Harz was elected executive vice president, operations, of Oak Manufacturing Company, Chicago, Ill. Mr. von Harz, who is also a director of the company, will be in charge of all manufacturing and engineering for Oak's multi-plant operations.

Kenneth A. Waldron has been named marketing manager for government and industrial products, CBS Electronics, Division of Columbia Broadcasting System, Inc. Mr. Waldron was previously manager of government sales.

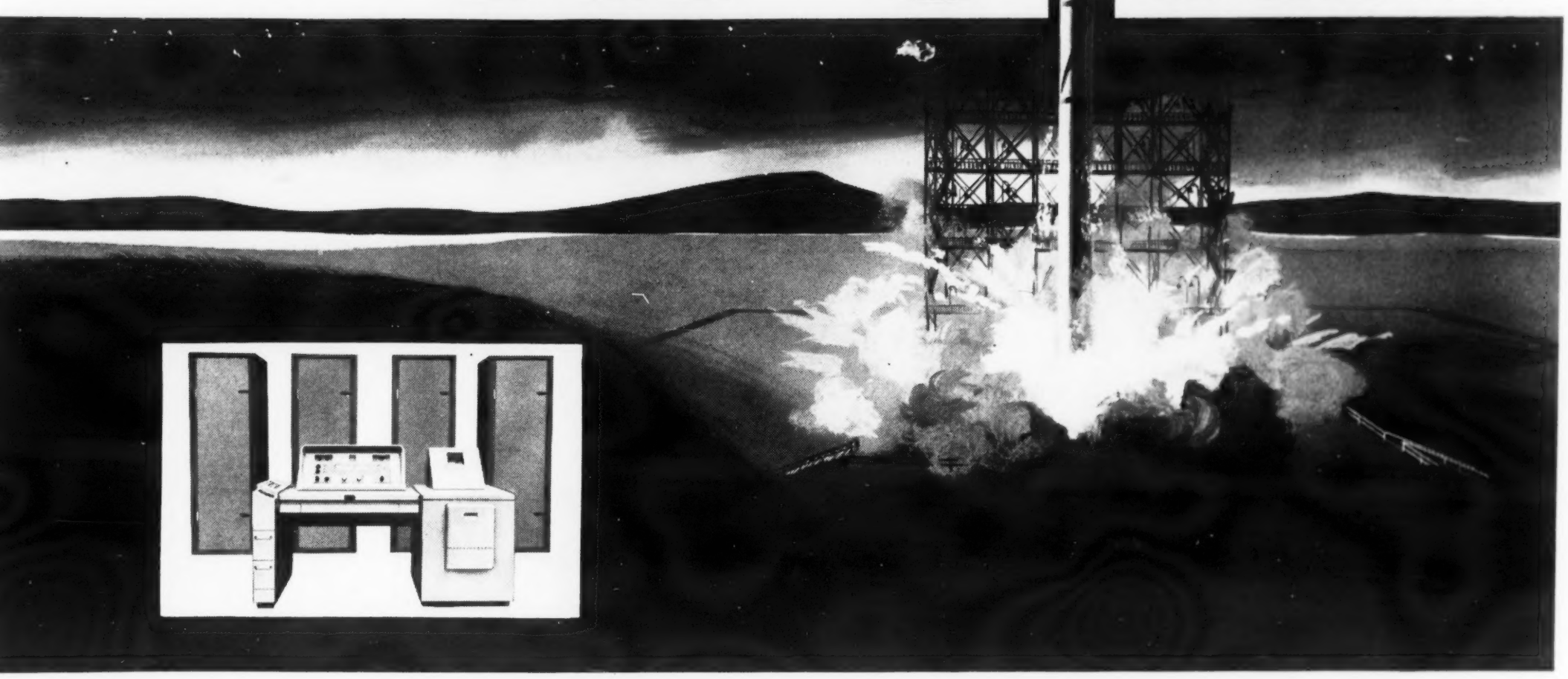
Donald K. deNeuf was elected executive vice president and a director of Press Wireless, Inc.

Dr. Charles R. Burrows has joined Page Communications Enginers, Inc., as vice president and director of research and development. Prior to joining Page, Dr. Burrows was vice president of Engineering for Radiation, Inc.

APCHE

The Checkout that says "GO" or "NO GO"

(Pronounced "AP-SHE")



APCHE (Automatic Programmed Checkout Equipment) is a solid-state, universal, high-speed, highly reliable, compact general-purpose tester designed especially for automatic checkout of aircraft, missile and space systems and their supporting systems. In its various versions (differing in input media, size and weight) APCHE installations may be fixed, mobile, airborne or submarineborne. APCHE was designed and is being produced as a part of RCA's ground support electronics subcontract from the Convair (Astronautics) Division of General Dynamics Corporation, prime contractor for the ATLAS Intercontinental Ballistic Missile.

The system being supplied to Convair for the ATLAS Program includes a console and four rack cabinets providing both analog and discrete test functions with a resulting printed and GO-NO GO indication. As a product of RCA's Missile Electronics and Controls Department, Burlington, Massachusetts, APCHE is one of the latest RCA developments in the field of military weapon readiness equipments.

RCA Tmk(s) ®

RADIO CORPORATION of AMERICA

DEFENSE ELECTRONIC PRODUCTS • CAMDEN, NEW JERSEY

TALL TALE FROM TEXAS

A few years after the Battle of the Alamo, a Texan was showing a friend from Oklahoma around the famed battle site.

Everything was preserved just as it had been on the historic day. The donkey still plodded patiently on his treadmill, making the great radar antenna turn round and round.

"What's that?" the man from Oklahoma asked.

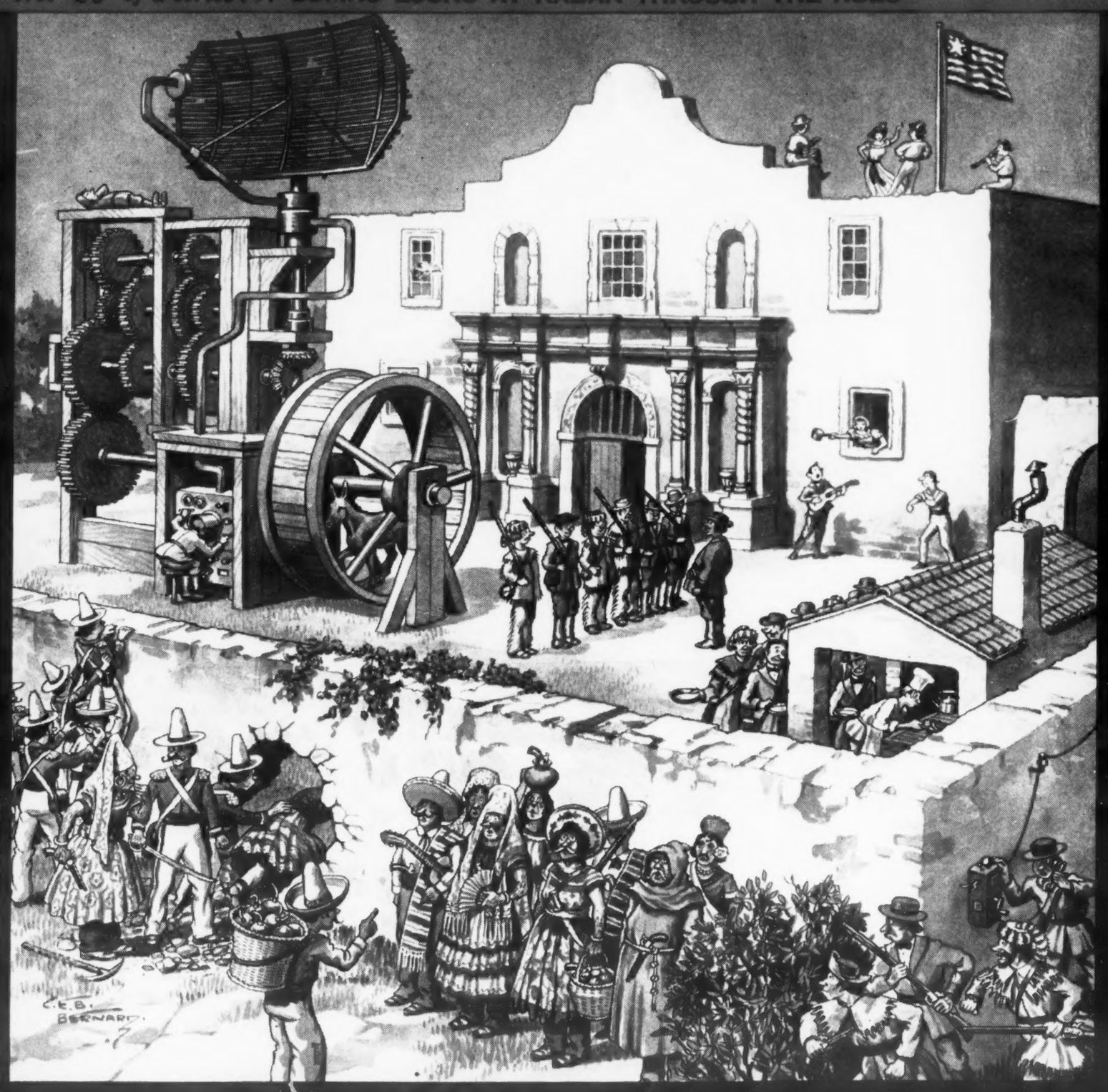
"Why anybody knows what that is!" the Texan said. "That's radar. Invented right here in Texas. It can see in the dark, this radar can. You can't make a move without its knowing it, no matter if you're two miles away."*

"If that's what radar is — some ass on a treadmill, goin' nowhere . . . for something that can see in the dark and you can't get away from — we've had them in Oklahoma for years."

"You've had radars for years?"

"Sure," the Oklahoman said. "Only we call 'em husbands and wives."

No. 20 of a series . . . BOMAC LOOKS AT RADAR THROUGH THE AGES



* *Today, Bomac makes the finest microwave tubes and components since the Texans invented radar.*

BOMAC

Leaders in the design, development and manufacture of TR, ATR, Pre-TR tubes; shutters; reference cavities; crystal protectors; silicon diodes; magnetrons; klystrons; duplexers; pressurizing windows; noise source tubes; high frequency triode oscillators; surge protectors.

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